



C. R. Young



BUILDING CODE

RECOMMENDED BY

THE NATIONAL BOARD
OF
FIRE UNDERWRITERS

NEW YORK

An Ordinance providing for fire limits,
and regulations governing the con-
struction, alteration, equipment,
repair, or removal of build-
ings or structures

FOURTH EDITION

Revised Reprint 1922

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Foreword

SINCE the publication in 1905 of the first issue of this Building Code, it has passed through three editions, with numerous reprints, and over 30,000 copies have been distributed to the public

The "Foreword" of the original edition contained the following paragraphs:

"In the belief that safe and good construction of buildings should be universally recognized as of the utmost importance, this Building Code, prepared and recommended by the undersigned Committee, is based on broad principles which have been sufficiently amplified to provide for varying local conditions. * * *

Thousands of human lives and millions of dollars' worth of property have been sacrificed by the criminal folly of erecting unsafe or defective buildings. So long as those in authority permit such buildings to be erected, neither life nor property can be safe. A remedy safeguarding both may be found in this book. The vital importance of its principles should arouse municipal authorities everywhere to a realizing sense of their duty and to the grave responsibility that rests upon them to enact and enforce adequate building laws for the protection of life and property."

The Committee considers those statements as true to-day as when first presented, and believes they apply to this revised edition with even greater force than to the one for which they were originally written. In the period intervening between the two, the art of building construction advanced with remarkable rapidity. Materials employed and methods of use have changed radically in certain directions, making a revision of the Code a necessity. The need for occasional revision was foreseen and indicated when the Code was first written, and will of course be required from time to time to meet changing conditions.

The Committee in presenting this completely revised edition, believes it offers to the public a safe, practical, conservative building ordinance which represents the best engineering practice of the day.

The revised edition contains three new features. One is the use of numerous notes scattered through the text, serving either as recommendations, cautions, or explanation. The second is the introduction of cuts illustrating details of construction, and the third is the use of frequent cross references in the text which will aid in quickly finding allied subjects. The object of these changes is to make the Code a guide or text-book for the use of Commissions engaged

in drafting building ordinances, and is designed to cover all the essential features of construction which such a Commission would be likely to discuss. The Committee recognizes it is impracticable to draft a standard code suitable for adoption without change by cities in all parts of the country. Local conditions must necessarily govern regulations covering sanitation, morals, or other important subjects which may be deemed desirable to include in the building code of a city but which are only treated incidentally here.

Attention is called to the "Suggested Building Ordinance for Small Towns and Villages" also issued by the National Board of Fire Underwriters for the use of municipalities too small to require an ordinance as comprehensive as this one.

The Committee welcomes correspondence from cities which are drafting new Codes or revising old ones, and is prepared to furnish assistance gratis in such work so far as it can consistently.

The Committee desires to express its appreciation of the assistance rendered it by helpful suggestions, and valuable criticisms willingly given by many structural engineers and architects whose wide practical experience made their comments most valuable.

C. G. SMITH, *Chairman.*

A. G. McILWAINE, Jr.	J. H. KELLY,
N. S. BARTOW,	J. H. BURGER,
E. T. CAIRNS,	J. H. BREWSTER,

*Committee on Construction of Buildings
National Board of Fire Underwriters.*

Address correspondence to

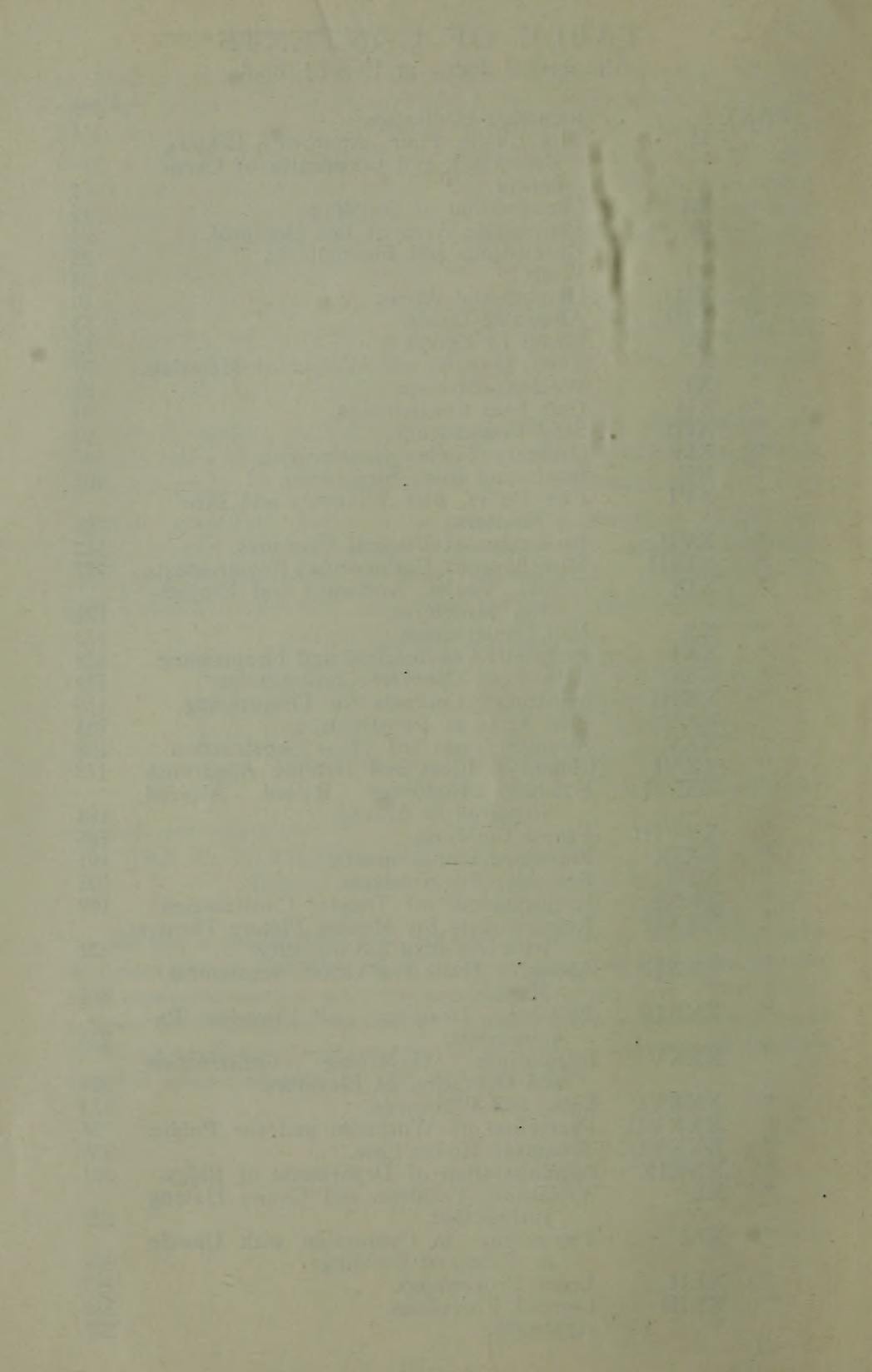
IRA H. WOOLSON, Consulting Engineer,
National Board of Fire Underwriters,
76 William St., New York City

In the compilation of a volume containing such a variety of inter-related subjects as this, it is quite probable that errors and inconsistencies may have escaped attention. The Committee will welcome notice of any discrepancies, or any suggestions tending to betterment of the Code. These will receive careful consideration for the next edition.

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BUILDING CODE.

The City Council of the City of.....
do ordain as follows:

PART I.

A REMEDIAL ORDINANCE.

Section 1. This Ordinance to be Known and Cited as the Building Code.

The following provisions shall constitute and be known as the Building Code, and may be cited as such and presumptively provide for all matters concerning, affecting or relating to the construction, equipment, alteration, moving or removal of buildings or any structure whatsoever erected or to be erected in the city of.....

Unless existing buildings or structures are specifically mentioned, the provisions of this Code shall apply only to buildings or structures *hereafter* erected or altered.

Section 2. Building Code a Remedial Ordinance Applying to New Buildings, and Buildings to be Altered or Repaired. This Ordinance is hereby declared to be remedial, and is to be construed liberally to secure the beneficial interests and purposes thereof.

PART II.

FIRE LIMITS, PLANS, APPROVALS, REPAIRS, DEFINITIONS AND CERTIFICATE OF OCCUPANCY.

Section 3. Fire Limits. The following shall be and are hereby declared to be the fire limits: Beginning at (Insert here boundary of the fire limits, which should include the business district, and several blocks around it. It should also include manufacturing sections, and any mercantile section) to the point of beginning.

Section 4. Building Construction to Conform to Code.

1. No wall, structure, building, or part thereof, shall hereafter be built or constructed, nor shall the plumbing, drainage, piping, or wiring of any building, structure or premises, be installed or altered, except in conformity with the provisions of this code.

2. No building already erected, or hereafter to be built, shall be raised, altered, moved or built upon in any manner that would be in violation of any of the provisions of this Code, or the approval issued thereunder.

Section 5. Filing Plans and Statements.

1. Before the erection, construction or alteration of any building or structure, or part of same and before the installation or alteration of the plumbing, drainage, piping or wiring of any building, structure, or premises is begun, there shall be submitted to the Superintendent of Building Construction an application in triplicate on appropriate blanks to be furnished by the Superintendent, containing a detailed statement of the specifications including the maximum live load for which each floor is designed when floor construction is involved in the proposed work, and accompanied by a full and complete copy in triplicate of all necessary plans of such proposed work, and such detail structural drawings thereof as the Superintendent may require. An affidavit shall also be filed stating the proposed maximum number of persons to be accommodated at one time on each floor above the first story, and the proposed purpose for which each story is intended.

Note.—The object of requiring applications in triplicate is to insure that the architect shall have a set of plans and specifications as approved, as well as the sets filed at the Department and kept at the building.

2. *Application to be Attested.* The application shall contain a sworn statement giving the full name, residence and business address (by street and number, whenever possible) of the owner of the building and of the owner of the premises upon which the building or structure is to be erected, altered or removed, or in which the installation or alteration of plumbing, drainage, piping or wiring is to be made. The application shall describe

the location of the building, structure or premises, give the name and address of the responsible party or parties to whom notice shall be sent for any violation of this Code which may occur during construction or alteration, and the name and address of the architect or other representative duly authorized to perform or have performed said work.

3. *Application to be Made by Owner or Representative.* The application and statement shall be made by the owner or lessee of the entire building, or by an architect, builder or other duly authorized representative of the owner or lessee.

4. *Copy to be Kept at Building.* A copy of the aforesaid application and plans as approved by the Superintendent shall be kept at the building during the progress of the work and shall be open to inspection by officials of the Department of Buildings.

5. *Statements to be Kept on File.* The said attested statement and detailed application with copy of the plans shall be kept on file in the office of the Superintendent.

6. *False Swearing.* Any false swearing in a material point in any statement submitted in pursuance of the provisions of this section shall be deemed perjury, and shall be punishable as such.

7. *All Work to be Executed in Accordance with Specifications.* The erection, construction, or alteration of said building, structure, or any part thereof, and the installation or alteration of the said plumbing, drainage, piping, or wiring, shall not be commenced or proceeded with, except after written approval by the Superintendent of the applications, plans, and detail drawings, and the issuance of a written permit, and the work shall strictly conform to such applications, plans, detail drawings, and permit. In case adequate plans and statements are presented, the Superintendent may, at his discretion, issue an approval and permit for the construction of a part of a building before the approval of applications and plans of the complete structure.

8. *Amendments.* Amendments to applications, plans, and detail drawings may be made and the Superintendent shall approve them provided the applications, plans, and

detail drawings, when so amended, shall be in conformity with the provisions of this Code and requirements of the Superintendent in relation thereto.

9. *Revocation of Approval.* The Superintendent shall have power to revoke any approval for any material departure from the approved applications, plans and detail drawings, or in case any false statement or representation as to a material fact relating to the erection, alteration, or removal of the building has been made.

10. *Limitation of One Year.* All approvals of applications, plans, and detail drawings, and amendments thereto, shall expire by limitation one year from the date of the original approval of the applications, plans, and detail drawings, but the limitation shall not apply to the erection of a new building under approved applications, plans, and detail drawings, when work thereunder has been begun and carried on with reasonable continuity within one year from the original approval thereof, when the work to be performed is lawful, and can be carried on without violating any provision of this Code.

11. *Ordinary Repairs.* Ordinary repairs of buildings or structures, or of the plumbing, drainage, or piping thereof, the cost of which shall not exceeddollars, may be made without notice to the Department of Buildings, but such repairs shall not be construed to include the removal of any stone, concrete or brick wall, or any portion thereof; the removal or cutting of any beams or supports, or the removal, change or closing of any staircase, or opening in the exterior wall; or the alteration or removal of any house sewer, private sewer, or drainage system, or soil, waste or vent pipe; or repairs or alterations of light or power wiring.

12. *Approval or Rejection of Plans.* It shall be the duty of the Superintendent to approve or reject any plan filed with him pursuant to the provisions of this section within a reasonable time.

Section 6. Demolishing Buildings.

1. Before the demolition or removal of any building or structure is begun, a verified application shall be prepared by the owner, architect, builder or contractor, on appropri-

ate blanks furnished by the Superintendent, containing a statement of the facts in relation thereto, and as to the ownership and location thereof. The application shall be filed with the Superintendent, and a written permit obtained from him. Such permit shall expire by limitation two months from the date of its issue. The Superintendent shall be given not less than twenty-four hours' notice before the demolition of any building or structure is begun.

2. In demolishing any building or structure or part thereof, story after story shall be completely removed. No material shall be placed upon a floor of any building in the course of demolition; the bricks, timbers and other parts of each story shall be lowered to the ground immediately upon displacement. The material to be removed shall be properly wet to lay the dust incident to its removal.

3. When any building or structure over 40 feet in height is demolished, a shed covering shall be provided as required by Section 268.

Proceedings by Superintendent to remedy unsafe buildings, Sect. 321, par. 1.

Section 7. Definitions.

The following terms when used in this Code shall be construed to have the meaning here given them.

Words used in the present tense include the future as well as the present; the singular number includes the plural and the plural the singular; the word "person" includes a corporation or co-partnership as well as an individual; "writing" includes printing, printed, or typewritten matter.

1. *Apartment House.* Same as tenement house.

2. *Approved.* The term "approved" refers to a device, material, or construction which has been approved by the Underwriters' Laboratories; or such approval may be granted by the Superintendent of Building Construction as a result of tests or investigation made under his direction; or he may issue approval upon satisfactory evidence of competent and impartial tests or investigations conducted by others. See also Section 316, paragraph 4.

3. *Approved Fire-resistive Roofing.* Roofing which

shall at least meet the requirements of the test specified in Section 174, paragraph 8.

Note.—This definition refers only to the lowest grade of roofing material which may be approved for use within city limits or upon buildings which offer moderate exposure. High grade roofings should also be tested and classified to determine their adaptation for more severe exposure. See Note, Section 174, paragraph 8.

4. *Areaway*. An open sub-surface space adjacent to a building for lighting or ventilating cellars or basements.

5. *Area of a Building*. The area of the horizontal cross-section at the ground level measured to the center of party walls or fire walls, and to the outside of other walls.

6. *Basement*. A story partly but not more than one-half below the level of the curb.

7. *Bearing Wall*. A wall which supports any load other than its own weight.

8. *Bulkhead or Pent House*. A structure erected on the roof of a building for the purpose of enclosing stairways to the roof, elevator machinery, water tanks, ventilating apparatus, exhaust chambers or other building equipment machinery and for janitor's quarters. When used only for the above mentioned purposes, such structures need not be considered in determining the height of the building.

9. *Cellar*. A story whose height is more than one-half below the level of the curb. It shall not be counted as a story in determining the height of a building.

10. *Cement Mortar*. See Section 56.

11. *Cement Plaster*. A plaster composed of one part Portland cement, not more than three parts sand, and not more than 10 per cent. by volume of hydrated lime, with hair or other binder when necessary.

12. *Cement-tempered Plaster*. A lime plaster tempered with not less than 20 per cent. of Portland cement.

13. *Court*. See Tenement House Law, Section 270.

14. *Curb*. Wherever the word "curb" refers to the height of a building or to the definition of a basement or cellar, it shall be construed to mean the curb level or

established grade at the center of the principal front of the building fronting on one street only; in the case of a building fronting on two or more streets, the curb level at the center of the front facing on the highest curb shall be taken, unless the highest curb is more than 10 feet higher than the lowest curb, in which case the average level of the two curbs shall be taken. Wherever the word "curb" refers to an excavation, the level of the curb shall be taken at the intersection of the lot lines and the curb lines. In the case of a building fronting on two or more streets, the curb levels shall be taken on each street at the intersection of the lot lines and the curb lines, and their relation to an adjoining building or buildings be as though two or more excavations were to be made.

15. *Curtain Wall.* Any non-bearing wall between columns or piers and which is not supported by beams or girders at each story. See Section 28.

16. *Dead Load.* The weight of the walls, framing, floors, roofs, tanks with their contents, and all permanent construction.

17. *Department.* The Department of Buildings.

18. *Division Wall.* Any interior wall in a building.

19. *Dwelling.* A residence building, designed for, or used as, the home or residence of not more than two separate and distinct families.

20. *Enclosure Wall.* See Panel Wall.

21. *Existing Building.* A completed building or structure, or one for which plans have been filed previous to the date on which this Code goes into effect.

22. *Exterior Wall.* Any outside wall, or vertical enclosure of a building, other than a party wall.

23. *Factory.* A building or portion thereof, designed or used to manufacture or assemble goods, wares, or merchandise, the work being performed wholly, or principally by machinery.

24. *Fibre Plaster Board.* A board consisting of an intimate mixture of gypsum plaster composition and a fibrous binding material.

25. *Fire Door*. A door, frame, and sill which will successfully resist a fire for one hour in accordance with test specifications given in Section 174, and has been approved upon such test. For self-closing and automatic fire doors, see Section 29, paragraph 4, note.

26. *Fire Exit Partition*. A sub-dividing partition built for the purpose of protecting life by providing an area of refuge. See Section 47.

27. *Fireproof*. As used in this Code, except as elsewhere prescribed by test for particular types of construction, refers to materials or construction not combustible in the temperatures of ordinary fires, and which will withstand such fires without serious impairment of their usefulness for at least one hour.

NOTE.—It is recognized that the term "fireproof" is misleading and should be abandoned for the more correct term "fire-resistive"; but until the latter term has been authoritatively defined in a manner expressive of its elastic interpretation, it seems advisable to continue the use of the more common though objectionable word.

28. *Fireproof Construction*. See Sections 110 to 173.

29. *Fire Shutter*. A shutter which will successfully resist a fire for one hour in accordance with test specifications given in Section 174, and has been approved upon such test.

30. *Fire Wall*. A wall built for the purpose of restricting the area subject to the spread of fire. See Section 29.

31. *Fire Window*. A window frame, sash, and glazing which will successfully resist a fire for one hour in accordance with test specifications given in Section 174, and has been approved upon such test. No single pane in a fire window shall exceed 720 square inches.

32. *Foundation Wall*. Any wall or pier built below the curb level or nearest tier of beams to that level.

33. *Garage*. A garage is (a), that portion of a structure in which a motor vehicle containing volatile inflammable oil in its fuel storage tank is stored, housed or kept; (b), all that portion of such structure that is on, above, or below the space mentioned in (a), which is not separated therefrom by tight, unpierced fire-walls and fire-proof floors.

34. *Gypsum Block.* The term "gypsum block" shall include tile or blocks composed of gypsum and not to exceed 5 per cent, by weight of combustible fibre binding material; or a mixture of crushed cinders and gypsum, commonly called "cinder-plaster blocks."

35. *Gypsum Mortar or Plaster.* See Section 57.

36. *Height of a Building.* The vertical distance from the curb level to the top of the highest point of the roof beams in the case of flat roofs, or to the average height of the gable in the case of roofs having a pitch of more than 20 degrees with a horizontal plane. When a building faces two or more streets having different grades, the measurement shall be taken at the middle of a facade on the street having the greatest grade. When a building does not adjoin the street, the measurement shall be taken from the average level of the ground adjoining such building. In measuring the height of a wall, the height of the parapet above the top of the roof beams shall not be included. See Section 83, paragraph 3.

37. *Horizontal Exit.* See Section 46, paragraph 2 (c).

38. *Hotel.* Any building or portion thereof, designed or used for supplying food or shelter to residents or guests, and containing more than fifteen sleeping rooms above the first story.

39. *Incombustible.* Materials or construction which will not ignite and burn when subjected to fire.

40. *Length of a Building.* Its greatest horizontal dimension.

41. *Live Load.* All loads other than dead loads. All partitions which are subject to removal or rearrangement shall be considered as live load.

42. *Mill Construction.* See Section 102.

43. *Non-bearing Wall.* One which supports no load other than its own weight.

44. *Non-fireproof Construction.* See Section 10.

45. *Occupied.* Shall be construed to mean occupied, to be occupied, or intended or designed to be occupied.

46. *Office Building.* One used for professional or clerical purposes, but not for manufacturing, storage, or

sale of goods except by sample; also excepting the first story which may be used for commercial purposes. No part of such building shall be used for living purposes except by the janitor's family.

47. *Ordinary Construction.* See Section 10.

48. *Outhouses.* All structures not exceeding 8 feet in height, nor more than 150 square feet in area, exclusive of sheds.

49. *Owner.* Any person, firm or corporation owning or controlling property, and includes a duly authorized agent or attorney. Guardians, conservators or trustees shall also be regarded as owner.

50. *Panel or Enclosure Wall.* A non-bearing wall in a skeleton structure built between columns or piers and supported at each story. See Section 27.

51. *Parapet Wall.* That portion of any wall which extends above the roof line and bears no load except as it may serve to support a tank. See Section 30.

52. *Party Wall.* A wall used or adapted for joint service between two buildings.

53. *Public Building.* See Section 11, paragraph 2.

54. *Public Hallway.* A hall, corridor or passageway used in common by the occupants of a building and serving as a means of communication for the public between an entrance to any story of a building and the various rooms, apartments or spaces in that story.

55. *Retaining Wall.* One constructed to support a body of earth or to resist lateral thrust.

56. *Shed.* A roofed structure, open on one or more sides, which does not exceed 15 feet in height nor more than 500 square feet in area.

57. *Skeleton Construction.* A form of building construction wherein all external and internal loads and stresses are transmitted to the foundations by a rigidly connected framework of metal or reinforced concrete. The enclosing walls are supported by girders at each story.

58. *Skylight.* Any cover or enclosure placed above roof openings for the admission of light.

59. *Slow-burning Construction.* See Section 10.

60. *Smokeproof Tower.* See Section 45, (b).

61. *Story.* That part of any building comprised between any floor and the floor or roof next above. In case any floor or the combined area of floors at any one level extends over less than 20 per cent. of the horizontal area included within the outside walls at that level, the same shall not be considered as a floor for the purpose of determining story heights.

62. *Structure.* Includes the terms building, appurtenance, wall, platform, staging, or flooring used for standing or seating purposes; a shed, fence, sign, or billboard on public or private property, or on, above or below a public highway.

63. *Superintendent.* The *Superintendent of Building Construction*, or such other official title as a city charter may apply to that office or position, which has assigned to it such duties as are generally recognized in supervising building construction. It shall also include any deputy or assistant authorized to represent such public official.

64. *Tenement House.* See Tenement House Law, Section 270, paragraph 1.

65. *Theatre.* Any building or part of a building designed or used for theatrical or operatic purposes with accommodation for an audience of more than three hundred persons, and having a permanent stage upon which movable scenery and theatrical appliances are employed; including also moving picture theatres, either with or without a stage and having capacity as above stated. See also Sections 255 and 256.

66. *Warehouse.* A building or portion thereof, designed or used for the storage of merchandise.

67. *Width of a Building.* The horizontal dimension next in value to the length.

68. *Wired Glass.* Glass not less than $\frac{1}{4}$ inch thick enclosing a layer of wire fabric reinforcement having a mesh not larger than $\frac{7}{8}$ inch, and the size of wire not smaller than No. 24 B. and S. Gauge.

69. *Workshop.* A building or room in which articles of merchandise are manufactured or repaired wholly or principally by hand.

70. *Yard.* See Tenement House Law, Section 278.

Section 8. Certificate of Occupancy.

1. Upon completion of such building, structure or alteration, provided no violations of this Code exist, the Superintendent shall issue to the owner a Certificate of Occupancy of the proposed building or part thereof, stating the purposes for which the building or structure may be used; also the maximum live load, and maximum number of persons that may be accommodated on each floor thereof.

2. The Superintendent shall upon application issue a temporary certificate of occupancy allowing the use of a portion of any building, provided no violation of the Code exists against that portion, and provided such temporary use of said portion would not endanger life or property.

3. No building, structure or part thereof shall be altered or converted in a manner to affect its occupancy, or used for any purposes whatsoever until the issuance of a certificate of occupancy; nor shall any building, structure or part thereof be occupied or used for any other purpose, or in any manner other than that prescribed in said certificate of occupancy; nor shall any building or structure or part thereof be burdened by any greater load, or be occupied by a greater number of persons than designated in said certificate.

Certificate of occupancy for an existing building as result of a survey, Section 48, par. 2.

4. The owner of every building of classes B, E and F shall post in a conspicuous place in each story, one or more signs giving maximum number of persons, purposes of use, and maximum live load for which certificate has been issued for that particular story.

Section 9. Change of Occupancy.

1. No change in the manner of occupancy shall be made in any story of any building or structure, or portion thereof, tending to increase the floor loads or the number of persons to be accommodated therein until there shall have been issued by the Superintendent a Certificate of Occupancy covering such new use or manner of occupancy; nor shall the manner of occupancy nor the purpose for which any building or structure or portion thereof is used be changed, except in conformity with the requirements of this Code, as to exits and floor loads.

2. The Superintendent shall cause any building or story therein to be vacated whose occupancy has been changed, or floor loads increased in violation of paragraph 1 of this section, and it shall not again be occupied until made to conform with the requirements of this Code.

PART III.

CLASSIFICATION OF BUILDINGS.

Section 10. Classification of Buildings by Construction.

1. For the purposes of this Code buildings shall be classified according to the method of construction as follows:

- I. Frame Construction.
- II. Non-Fireproof Construction.
 - a. Ordinary Construction.
 - b. Mill Construction.
- III. Fireproof Construction.

2. *Frame Construction.* A building having the exterior walls or portions thereof of wood; also a building with wooden framework veneered with brick, stone, terra cotta, or concrete; or covered with plaster, stucco, or sheet metal, shall be classed as a frame building.

Frame buildings, Secs. 187-192.

3. *Non-Fireproof Construction.* The term "Non-Fireproof Construction" shall apply to all buildings or structures having exterior masonry walls with floors and other interior construction wholly or in part of wood.

- (a) *Ordinary Construction.* A building having masonry walls, with floors and partitions of wooden joist and stud construction. The supporting posts and girders may be of wood, or of metal protected as required in Section 114.
- (b) *Mill Construction.* (Sometimes called "Slow-burning Construction.") A building having masonry walls, and heavy timber interior construction. See Section 102.

4. *Fireproof Construction.* Buildings of masonry, steel, or reinforced concrete construction in accordance with Sections 110 to 173, shall be considered fireproof.

Section 11. Classification of Buildings by Occupancy.

1. All buildings shall be classified according to their occupancy or use under one of the three following groups: Public Buildings, Residence Buildings, and Business Buildings. These groups shall be further sub-divided into six classes, two in each group, designated as A, B, C, D, E and F, as follows:

- I. Public Buildings:
 - Class A,
 - Class B.
- II. Residence Buildings:
 - Class C,
 - Class D.
- III. Business Buildings:
 - Class E,
 - Class F.

2. *Public Buildings. When Required Fireproof.* Public Buildings shall be construed to include all buildings or structures accessible to the public, and in which people may congregate for military, civic, political, educational, religious, amusement or transportation purposes; or in which they may be voluntarily or forcibly detained or housed for safety, punishment, observation, or care.

Class A. Armories, Asylums, Bath Houses (with sleeping accommodations other than those required for janitor), City Halls, Colleges, Court Houses, Detention Buildings, Police Stations, Hospitals, Libraries, Museums, Nurseries, Railway Passenger Stations, Schools, and Theatres..

Buildings of this class shall be of fireproof construction, except that schools in which no pupils are accommodated above the second story may be of non-fireproof construction.

Where armories, railway passenger stations, museums and similar buildings have large arched exposed roof construction, the fireproofing of the structural members of these roofs may be omitted if, in the opinion of the Superintendent, the construction of the remainder of the building would reasonably warrant such omission.

Class B. Amusement Halls, Churches, Exhibition Buildings, Lodge Rooms, and Public Halls.

All buildings of this class shall have the floor over cellar or basement which is nearest to grade level of fireproof construction.

Buildings of this class over three stories, or 40 feet high, shall be of fireproof construction throughout, except that church spires need not be fireproof until they exceed 75 feet in height.

Restrictions on wooden spires, Sec. 188.

Every permanent structure intended for the seating or accommodation of the public, commonly known as grandstands, erected within the fire limits, shall be of fireproof construction, except that the seats may be of wood, and the structural steel work may be unprotected. When portions of such structures are enclosed, the enclosing construction shall be fireproof.

3. *Residence Buildings. When Required Fireproof.* Residence Buildings shall be construed to mean and include all buildings in which sleeping accommodations (other than for janitor or watchman) are provided.

Class C. Bachelor Apartments, Club Houses, and Studios with more than 15 sleeping rooms, Dormitories, Hotels and Lodging Houses.

Buildings of this class when permitted of frame construction shall not exceed two stories or 30 feet in height.

All buildings of this class three stories in height shall have the floor over the cellar or basement which is nearest to grade level of fireproof construction.

Buildings of this class over three stories or 40 feet high, shall be of fireproof construction throughout.

Class D. Dwellings, Tenement Houses, and all other Residence Buildings not specified in Class C.

Buildings of this class over three stories, or 40 feet high, shall have the floor over cellar or basement which is nearest to grade level of fireproof construction.

Buildings of this class over four stories, or 55 feet high, shall be of fireproof construction throughout.

When the lower stories or portions thereof in non-fireproof buildings of Classes C and D are occupied for business purposes, the construction shall be made in accordance with the requirements of Section 98.

Cellar ceilings when first floor is not fireproof, Sec. 99, par. 5.

Frame buildings, Sec. 187-192.

Frame tenements, Sec. 301.

4. *Business Buildings. When Required Fireproof.* Business Buildings shall be construed to mean and include all structures used for or adapted to the transaction of business, the operation of machinery, the manufacture or storage of machinery or materials, the housing of live stock, or for any other industrial purpose.

Class E. Factories, Lofts, Office Buildings, Printing Houses, Restaurants, Stables, Stores, Warehouses, and Workshops.

Buildings of this class of ordinary construction over two stories, or 30 feet high, shall have the floor over the lowest story of fireproof construction; buildings of this class over four stories, or 55 feet high, shall be of fireproof construction throughout, or of mill construction.

Class F. Car Barns, Foundries, Light and Power Plants, Railroad Freight Stations, Ice Houses; also Special Industry Buildings, constructed and occupied exclusively for a special purpose or industry and not otherwise classified, such as Coffee Roasters, Cooperage Shops, Dry Cleaning Establishments, Grain Elevators, Ice-Making Plants, Laboratories, Malt Houses, Oil Houses, Oil Refineries, Refrigerating Plants, Rendering Plants, Soap Factories, Sugar Refineries, Smoke Houses, Slaughter Houses, Wharf Buildings, also Garages accommodating more than three cars, or in which cars are stored on more than one floor.

Buildings of this class, such as garages (as defined in Sect. 7), oil houses, oil refineries, rendering plants, smoke houses, varnish works, etc., and buildings or portions of buildings which are used for the storage or handling of large quantities of combustible packing or refuse material,

shall be only of fireproof construction. All other buildings of Class F shall be of fireproof or mill construction if within the fire limits or if they exceed 55 feet in height.

Height of mill construction, Sec. 37.

Definition of garage, Sec. 7, par. 33.

Buildings of Class F, whether of fireproof or non-fireproof construction and within the fire limits, or of non-fireproof construction and outside the fire limits, shall only be erected in such isolated localities and under such conditions as are approved by the Superintendent of Building Construction.

NOTE.—It is recommended that dry-cleaning establishments, garages (as herein defined), oil houses, oil refineries, varnish works, etc., whether in new buildings or altered buildings, shall conform to the regulations of the "Ordinance Regulating the Use, Storage and Sale of Inflammable Liquids," issued by the National Board of Fire Underwriters.

Buildings of Class F, frame construction, Sec. 188.

Storage of lumber shall not be permitted within the fire limits unless the stock is stored in sheds or buildings with incombustible walls and approved roofs.

5. Unless special exception is made, every provision of this Code applying to any building of a class shall apply to all buildings of that class.

6. When any building is not classified, or where there is any doubt as to its classification, the Superintendent shall designate under which class it shall be placed.

7. When any building is used for the purpose of two or more classes as herein defined, that portion devoted to the occupancy or use of a particular class shall be constructed in accordance with the requirements of that class, unless such construction shall in the opinion of the Superintendent prove impracticable, or where there shall be a conflict between the requirements of the different classes, in which case the class requiring the safest form of construction shall govern the entire building.

A public record of all classifications of buildings made by the Superintendent shall be kept on file in the Department of Buildings in accordance with the provisions of Section 316.

PART IV.

PERMISSIBLE AREA OF LOT OCCUPIED.

Section 12. Limits of Lot Area Occupied.

1. Except as hereinafter provided, all buildings shall have uncovered spaces for providing light and air. These spaces shall be open to the sky from the top of the second story window sills and shall be in accordance with the following table; in which all paragraphs from 2 to 11 inclusive shall be read as if containing the words "except theatres, special industry buildings, and tenement houses."

Lot area occupied by tenements, Sec. 276.

2. Buildings of Class C, on lots other than corner lots:
20 per cent. of total lot area when not exceeding 75 feet in height.

25 per cent. of total lot area when over 75 feet and not exceeding 125 feet in height.

Buildings of Class C, on corner lots:

15 per cent. of total lot area when not exceeding six stories or 75 feet in height, and shall increase 2 per cent. for each additional story up to 125 feet in height.

3. All buildings not enumerated in paragraph 2 on lots other than corner lots.

10 per cent. of total lot area when not exceeding 75 feet in height.

12½ per cent. of total lot area when over 75 feet and not exceeding 125 feet in height.

4. All buildings not enumerated in paragraph 2 on corner lots not exceeding 2500 square feet in area:

5 per cent. of total lot area when not exceeding 75 feet in height.

7½ per cent. of total lot area when over 75 feet and not exceeding 125 feet in height.

5. When buildings are on corner lots, more than 2500 square feet in area, that portion of the building upon the excess lot area over and above 2500 square feet shall be provided with open spaces in accordance with the requirements of paragraph 2, or 3, as the case may be of this section.

6. Every building (other than buildings of Class C) which occupies lots fronting upon three or more streets may occupy the entire lot area, provided the maximum width of the building does not exceed 75 feet.

7. The total area of the uncovered spaces of all buildings which are more than 75 feet in width and occupy an entire block front facing upon three or more streets may be less by 25 per cent. than is required by the provisions of paragraphs 3, 4, 5, and 6 of this section.

8. There shall be a clear space not less than 5 feet in width, at and above the second story window sills, between the rear line of every building and the rear line of every lot except corner lots. This shall not apply to buildings which extend through from one street to another.

9. In every court or yard the distance between opposite boundary walls shall not be less than 5 feet at any point for a height not exceeding 75 feet, and shall be at least $\frac{1}{2}$ inch greater throughout its height for every additional foot above 75 feet.

10. When existing buildings are extended or increased in area, the ratio of total uncovered space to the area of the lot shall not be required to be greater than it would be were the entire building erected in accordance with this Code.

11. In order to fulfill the requirements of this section, uncovered spaces may be increased in size as they go upward if thereby they provide at every given level the requisite area of uncovered space for a structure of that particular height.

Light and ventilation, Sec. 95.

PART V.

EXCAVATIONS AND FOUNDATIONS.

Section 13. Excavations. The person causing any excavation to be made for a building, shall have the same properly guarded and protected. Wherever necessary he shall at his own expense properly sheath pile and erect masonry or steel construction, or a sufficient retaining wall to permanently support the adjoining earth. Such retain-

ing wall shall extend from full depth of excavation to the level of the adjoining earth and shall be properly coped.

Section 14. Excavations Affecting Adjoining Property.

1. Whenever an excavation is not intended to be or shall not be carried to a depth of more than 10 feet below the curb level, the owner of every adjoining or contiguous wall or structure, yard, or bank of earth or rock shall protect the same, so that they shall be and remain as safe as before such excavation was begun. Such owner shall be permitted to enter upon the premises where the excavation is being made when necessary for this purpose.

2. Whenever an excavation of either earth or rock for buildings or other purposes shall be intended to be or shall be carried to the depth of more than 10 feet below the curb, the person causing such excavation to be made shall at all times from the commencement until the completion thereof, if accorded the necessary license to enter upon the adjoining land, and not otherwise, at his own expense preserve any adjoining or contiguous wall, structure, yard, or bank of earth or rock from injury, and support the same by proper foundations or retaining walls, so that the said wall, structure, yard, or bank of earth or rock shall be and remain practically as safe as before such excavation was commenced, whether the said adjoining or contiguous wall, structure, yard, or bank of earth or rock are down more or less than 10 feet below or above the curb. For this purpose such approved foundations or retaining walls may be built upon the property upon which the wall, structure, yard, or bank of earth or rock is situated. If the necessary license is not accorded to the person or persons making such excavation, then it shall be the duty of the owner refusing to grant such license at his own expense to make the adjoining or contiguous wall, structure, yard, or bank of earth or rock safe, and support the same by proper foundations so that adjoining excavations may be made, and shall be permitted to enter upon the premises where such excavation is being made for that purpose, when necessary.

Section 15. Foundations Adjoining Party Walls.

1. In case a party wall is intended to be used by the person causing an excavation to be made, and the footings and foundations of such party wall are in good condition and sufficient for the uses of both the existing building and the new one, then the person causing the excavation to be made shall, at his own expense, preserve such party wall from injury and support the same by proper means, so that said party wall shall be and remain as safe as before the excavation was begun.

2. In case the footings and foundations of any said party wall are not in good condition, or not sufficient for the uses of both the existing building and the new one, it shall be the duty of the person causing such excavation to be made to extend such defective or insufficient footing or foundation, or to replace same with a new footing or foundation. Such extended or new footing shall project on each side of the party line such a distance as to bring the center of the footing under the center of the wall, so that the total load upon the wall may be uniformly distributed over the area of the footing. Any other method may be used which will adequately support the party wall. In order that this may be done, the person causing the excavation to be made shall be allowed access to the adjoining premises.

3. In case any excavation or the removal of any existing building shows any adjoining wall or structure to be unsafe at the time the excavation was begun, it shall be the duty of the person causing the excavation to be made, or the building to be removed, to forthwith report the fact, in writing, to the Superintendent, who shall upon the receipt of such notice, forthwith cause an inspection of such adjoining premises to be made, and if such inspection proves the aforesaid wall or structure to be unsafe, it shall be the duty of the Superintendent to declare such wall or structure to be unsafe and cause the same to be repaired as herein provided.

4. If the person whose duty it shall be to preserve or protect from injury any wall or structure shall neglect or fail to do so within 24 hours after the receipt of a notice from the Superintendent, then the Superintendent may

enter upon the premises and employ such labor, and furnish such materials and take such steps as, in his judgment, may be necessary to make the premises safe and secure, or to prevent the same from becoming unsafe or dangerous, at the cost and expense of the person whose duty it is to keep the same safe and secure.

Section 16. Bearing Capacity of Soil.

1. When doubt arises as to the safe sustaining power of the soil upon which a building is to be erected, the Superintendent may order borings to be made, or he may order tests of the sustaining power of the soil to be made by and at the expense of the owner of the proposed building. Such test shall be made in accordance with specifications established by the Superintendent, and he shall be notified before any test is made, so that he may be present or represented thereat. The records of such borings or tests shall be filed in the Department of Buildings.

2. In the absence of tests the safe bearing capacity of different soils shall not exceed the values given in the following table:

Character of Soil.	Tons per Square foot
Soft clay	1
Firm clay, fine sand, or layers of sand and clay, wet	2
Clay or fine sand, firm and dry	3
Hard clay, coarse sand, gravel	4
Hard 'pan	8 to 15
Rock	15 to 72

Section 17. Foundation Walls.

1. Foundation walls shall be construed to include all walls and piers built below the curb level, or nearest tier of beams to the curb, or to the average level of the ground adjoining the walls, to serve as supports for walls, piers, columns, girders, posts or beams.

2. If built of rubble stone, they shall be at least 8 inches thicker than the wall next above them to a depth of 12 feet below the curb level; and for every additional 10 feet, or part thereof deeper, they shall be increased 4 inches in thickness.

3. If built of brick or plain concrete and supporting walls over 30 feet in height, they shall be at least 4 inches thicker than the wall next above them to a depth of 12 feet below the curb level; and for every additional 10 feet, or part thereof deeper, they shall be increased 4 inches in thickness. In buildings not exceeding 30 feet in height, the Superintendent may at his discretion permit the foundation walls to be the same thickness as the walls above.

4. Hollow blocks may be used for the foundation walls of buildings not exceeding three stories or 40 feet in height, provided said walls are not less than the thickness required for foundation walls of brick or plain concrete. All blocks shall be laid to line and level, and carefully bonded. When blocks are laid with cells vertical the stability of the walls and their resistance to water, may be increased by being filled solidly with wet concrete. Such foundations shall not be stressed beyond the limits allowed in Section 58, taken over combined area of blocks and fill.

NOTE.—Attention is called to the fact that foundation walls of hollow building blocks, even when filled with concrete, are sometimes not efficient in resisting moisture, and it is recommended that such walls be thoroughly waterproofed on the outside.

5. Portland cement mortar only, shall be used in footings and foundation walls.

Reinforced concrete walls, Sec. 147.

Section 18. Footings.

1. The footings for foundation walls, piers, and columns, shall be constructed of plain concrete, reinforced concrete, or of steel grillage beams resting on a bed of concrete. Wooden footings may be used if they are entirely below the level of low water.

2. Footings shall be so designed that the loads they sustain per unit of area shall be as nearly uniform as possible, and the stresses shall conform to the requirements of this Code. The dead loads carried by the footings shall include the actual weight of the superstructure and foundations down to the bottom of the footing. All tanks or other receptacles for liquids shall be figured as being

full. All vaults or similar built-in structures shall be considered parts of the building.

The live load on column footings shall be assumed to be the same as the live load in the lowest tier of columns.

3. Loads exerting pressure under the footings of foundations of buildings more than three stories in height, shall be computed as follows:

- (a) For buildings in which the required live load does not exceed 75 pounds per square foot, assume the total dead load, plus 60 per cent. of the full live load.
- (b) For buildings in which the required live load exceeds 75 pounds per square foot, assume the total dead load, plus 75 per cent. of the full live load.

In no case shall the load per square foot under any portion of any footing due to the combined dead, live, and wind loads, exceed the safe sustaining power of the soil upon which the footing rests.

4. Concrete footings shall be not less than 12 inches thick, except as provided in Section 189.

5. Concrete for footings shall be made of at least one part of Portland cement, and not more than two and one-half parts of sand, and five parts of broken stone or gravel.

Quality of concrete, Sec. 60.

6. Broken stone shall be hard, durable, and of quality approved by the Superintendent. Where gravel is used it shall be thoroughly washed.

7. Where mass concrete is used for footings or foundations, the stone or gravel shall be of such size as will pass through a two-inch ring, and shall be free from dust or other deleterious material. Sufficient smaller aggregate shall be added to secure density.

NOTE.—Under some conditions it is permissible to embed large stones in mass concrete, it then being called "rubble concrete." Rubble concrete shall not be used for projecting footings.

8. Stepped up courses of brick shall have offsets of not more than $\frac{1}{2}$ inch if laid in single courses, and 1 inch if laid in double courses.

9. If the nature of the ground and the character of the building are such as to make it necessary or advisable,

isolated piers may be used instead of a continuous wall to support the building.

10. Grillage beams shall be united by bolts and separators, and the grillage filled solid with concrete. All metal which forms parts of any footing or foundation shall be protected from rust, by a wash of rich Portland cement grout, or by the use of other approved coating, and shall be entirely encased with at least 4 inches of concrete.

Mortar for footings, Sec. 25.

Section 19. Wooden Piles.

1. Wooden piles shall be of approved timber. They shall be sound and straight. The diameter at the butt shall be not less than 10 inches, and the diameter at the point shall not be less than 5 inches. Any pile over 20 feet in length shall not be less than 12 inches at the butt. The minimum distance between piles shall be 2 feet.

2. Piles shall be driven to refusal if possible, and the method of driving shall be such as not to impair their strength. The maximum load carried by a pile driven through firm soil to rock or hard pan shall be computed by multiplying the average area of cross section in inches by 500 lbs.; but in no case shall such load exceed 15 tons. Piles driven through loose wet soil to solid rock or hard pan, shall be figured as columns unsupported laterally for their entire length.

3. The safe sustaining power of a pile not driven to refusal, which shall in no case exceed 10 tons, shall be determined by calculation based upon the following formula:

$$L = \frac{2WH}{P + 1}$$

in which L = the allowable load in tons (maximum ten tons).

W = the weight of the hammer in tons.

H = the fall of the hammer in feet (maximum 15 ft.).

P = the average penetration in inches under the last five blows after the pile has sunk to a point where successive blows produce approximately equal penetrations.

The Superintendent shall be notified before any test is made of the sustaining power of piles, so that he may be present or represented thereat.

4. The sustaining power of wooden piles driven by steam or pneumatic hammers or by jetting shall be determined by test as directed by the Superintendent.

5. Piles shall be cut so that the tops are always below the level of mean low water. Portland cement concrete shall be rammed down in the interspaces between the heads of the piles to a depth of not less than 8 inches, and laterally for a distance of not less than 12 inches on each side of the rows of piles.

6. Under frame buildings piles may be capped with timbers; the timbers shall be sound wood, not less than 6 inches thick and properly joined together. The tops of all such timbers shall be below the level of mean low water, except in the case of frame buildings built over the water or on soft meadow, or similar land, in which case piles may project above the water a sufficient distance to raise the building above high tide, and then the building may be placed directly thereon.

Grading Rules for structural timbers, Appendix, page 279.

Section 20. Concrete Piles.

1. Piles consisting of steel tubes filled with concrete shall have a minimum inside diameter of 10 inches and the thickness of the metal tube not less than $\frac{3}{8}$ inch. The length shall not exceed forty times the inside diameter. The ends of the tube shall be faced perpendicular to its axis. No more than one slice of an approved design shall be used in the total length of the pile. When driven to rock the load on such piles shall not exceed over 500 lbs. per square inch on the concrete and 7500 lbs. per square inch on the steel. In computing the effective area of the steel, $\frac{1}{8}$ inch of its thickness shall be deducted from the thickness of the tube to allow for corrosion.

2. Concrete piles moulded and cured before driving shall be provided with not less than 2 per cent. nor more than 4 per cent. of longitudinal reinforcement with bands or hoops not less than $\frac{3}{8}$ inch diameter, and spaced not

further apart than 6 inches. The average diameter of the pile shall not be less than 12 inches, and the diameter at the foot not less than 8 inches. The length shall not exceed thirty times the average diameter for piles driven through firm soil, and shall not exceed fifteen times the average diameter for piles driven to rock through loose wet soil, or filled ground. When driven to rock the maximum load carried on such piles shall not exceed 6000 lbs. per square inch on the longitudinal reinforcement and 500 lbs. per square inch on the concrete at the average cross section.

The top of the piles shall be protected with a cushion cap of approved design, and when driven to rock the foot shall be provided with a metal shoe having a square bearing.

3. When piles of the types described in paragraphs 1 and 2 are not driven to rock their carrying capacity shall be determined by means of one or more test piles, and the working load shall not exceed one-half the test load under which the pile begins to settle, nor shall the prescribed unit stresses be exceeded.

4. Concrete piles cast in place shall be made in such manner as to insure the exclusion of any foreign matter, and to secure a uniform full-sized section for the entire length. The average diameter of the pile shall be not less than 14 inches and the diameter at the foot not less than 8 inches. The length shall not exceed twenty-five times the average diameter. The carrying capacity of such piles shall be determined by means of one or more test piles, and the allowable working load shall be not greater than one-half the test load under which the test pile begins to settle, nor greater than 350 lbs. per square inch.

NOTE.—Piles freshly cast in place are sometimes seriously injured by driving the core for a new pile too near. This should be avoided.

1. The concrete shall be mixed in the proportion of one part Portland cement, two parts of clean coarse sand, and four parts of broken stone or gravel of a size passing through a $1\frac{1}{4}$ -inch diameter ring, with sufficient water to produce a plastic or viscous consistency.

NOTE.—The size of the coarse aggregate shall always be such that the largest pieces will freely pass through the smallest spaces between reinforcement bars or hoops. In some cases it may be necessary to reduce the size above specified.

6. The clear space between the heads of concrete piles shall not be less than 16 inches.

7. The permissible load upon piles driven out of plumb, and the extent to which piles may be driven out of plumb before being condemned, shall be determined by the Superintendent.

8. No pile or group of piles shall be loaded eccentrically.

NOTE.—Care should be taken to remove all laitance from the top of piles before laying concrete upon them. Serious failures have resulted from neglect of this precaution.

PART VI.

WALLS.

Section 21. Brick Walls and Walls in General.

1. Every building other than frame buildings shall be enclosed on all sides with independent or party walls of incombustible materials. This shall not preclude the construction of any story supported on piers entirely open to the outer air, provided that in all such buildings the floor and the ceiling of such open story shall be protected by incombustible material.

Quality of brick, Sec. 51.

2. The masonry walls and piers of every building shall be properly and solidly bonded with mortar joints. They shall be built to a line and carried up plumb and straight.

3. All brick shall be thoroughly wet just previous to being laid, except in freezing weather, when they shall be thoroughly dry. No mason work of any description shall be built when the temperature is below 28 degrees Fahrenheit on a rising temperature, or 32 degrees on a falling temperature at the point where the work is in progress. No frozen materials shall be built upon, but shall be removed.

4. No wall of any building or structure shall be built more than two stories in advance of any other portions of the walls of the building or structure; this provision need not apply to buildings where walls are carried independently by girders at each floor. All walls shall be securely anchored and bonded at points where they intersect. Where such walls are not built at the same time, the perpen-

dicular joint shall be regularly toothed with 4-inch offsets, and the joint shall be provided with anchors not less than 2-inch by $\frac{3}{8}$ -inch metal, with bent-up ends or cross pins to form anchorage; such anchors are to be not less than 3 feet long, extending 18 inches on each side of the joint and spaced not more than 3 feet apart in height.

5. The walls and beams of every building during erection or alteration shall be securely braced wherever required until the building is enclosed.

6. In brick walls every sixth course shall be a heading course, except where walls are faced with brick in Flemish bond, in which case the headers of every third course shall be full brick and bonded into the backing. Where running bond is used, it shall be bonded into the backing by cutting the corners of every brick of every sixth course of the face brick and putting in a row of diagonal headers behind the same; suitable metal anchors shall also be used in the bonding course at intervals not exceeding 3 feet. Where face brick is used of a different thickness from the brick used for backing, the courses of the exterior and interior brickwork shall be brought to a level bed at intervals of not more than eight courses in height of the face brick, and the face brick shall be properly tied to the backing by a full heading course of the face brick or other approved method.

7. Face brick shall be laid at the same time as the backing, and shall in no case be laid after the backing is in place.

8. When walls of hollow blocks are veneered as permitted in Section 31, paragraphs 4 and 8, the facing shall either be bonded to the backing with a row of headers every 16 inches, or be attached to the backing with approved metal wall ties bedded in the mortar joints. Such ties shall not be spaced further apart on centers than one foot vertically and 2 feet horizontally. Such veneering shall not be considered a part of the required thickness of the wall. Brick facing or veneering may, however, be considered as part of a hollow terra cotta or concrete wall (or vice versa), provided the veneering is bonded at least 4 inches into the wall at intervals not exceeding six courses of brick. When

veneering is used special care shall be taken to fill all joints flush with mortar around wall openings.

NOTE.—Ordinary hollow building blocks are not suited for this latter bonding requirement; blocks of special size must be used to insure a proper spacing of the joints.

9. No timber, except inside lintels, as described in Section 35, and nailing blocks not over 8 inches in length, shall be placed in any masonry wall.

10. The walls of each story shall be built up the full thickness to the top of the beams above.

Foundation walls, Sec. 17.

Reinforced concrete walls, Sec. 147.

Section 22. Piers.

1. Every pier shall be built of squared stone, stone concrete, or approved brick. Stone or brick piers shall be laid in Portland cement mortar. Every exterior pier shall be securely anchored to the beams or girders at the level of each tier. The height of any isolated pier shall not be greater than ten times its least horizontal dimension. Except in frame buildings, no masonry pier shall be less than 16 inches square.

2. Interior piers shall not be built of stone, neither shall stone bonds or caps be used in such piers, except in frame buildings.

3. Every exterior stone or brick pier less than 6 square feet in cross-section, which supports a beam, girder, arch or column upon which a wall rests, or a lintel spanning an opening over 10 feet wide on which a wall rests, shall have built into it, at vertical intervals of not more than 30 inches, approved bond stones, steel, or cast iron plates. Bond plates shall be full size of the pier.

Steel bond plates shall be not less than $\frac{1}{2}$ inch in thickness and shall be perforated by three holes per square foot of area; the diameter of the holes shall be not less than $\frac{3}{4}$ inch.

4. Monolithic stone posts shall not be used for the support of columns, girders or walls.

NOTE.—The use of interior stone piers and of cap and bond stones in interior brick piers are prohibited because they are dangerous due to spalling when attacked by fire. Bond stones should be avoided in exterior piers wherever not really necessary for decoration. The perforating of the steel plate gives it a secure anchorage in the mortar. The number and size of the holes is immaterial provided they are sufficient to furnish a secure key.

Section 23. Stone Walls.

1. Every stone wall shall have one header extending through the wall in every 2 feet in height and every 3 feet in length. Headers shall be staggered. All headers shall be good, flat stones, not less than 12 inches wide and 8 inches thick.

2. All stones shall be laid on their natural bed. No stone which does not bond into the wall at least 6 inches shall be used. Stones shall be firmly bedded in mortar with all spaces and joints thoroughly filled.

3. Walls built of squared stone, with dressed level beds, shall have a thickness not less than that required for brick walls under similar conditions.

4. Walls built of rubble stone shall have such increase of thickness over that specified for squared stone walls as may be required by the Superintendent. Rubble stone walls shall not exceed three stories or 40 feet in height.

Section 24. Ashlar. Stone or architectural terra cotta ashlar, or other approved material used for the facing of any building or structure, shall be not less than 4 inches thick. In stone ashlar, each stone shall have a reasonably uniform thickness, but all stones need not necessarily be the same thickness. Each block of ashlar or other approved facing shall either be bonded into the backing, or be securely anchored to the backing with metallic anchors, at least one for each 30 inches lineal length of course, and the backing independent of facing shall conform to the wall thickness required by this Code. Where every alternate course of facing is at least 8 inches thick and bonded into

the backing, at least 4 inches, the ashlar may be counted as part of the thickness of the wall. No wall faced with ashlar shall be less than 12 inches thick.

Section 25. Mortar for Walls. Foundations, footings and parapet walls shall be laid in Portland cement mortar, also arches over doorways and windows. All chimneys shall be laid in Portland cement mortar. Other brick walls may be laid in lime, lime and cement, or cement mortar. Hollow block walls shall be laid in Portland cement mortar.

Quality of mortar, Secs. 52-57.

Mortar for fire walls, Sec. 29.

Mortar for chimneys, Sec. 178.

Section 26. Brick Wall Thicknesses.

1. All bearing walls shall be sufficient thickness to support the load to be carried without exceeding the stresses specified in Section 65, but in no case shall such walls be less than 12 inches thick, unless built of reinforced concrete.

Thickness of reinforced concrete walls, Sec. 147.

2. The minimum thickness of all brick bearing walls shall be in accordance with the following schedules and tables. In determining the thickness of walls for varying heights, they shall be measured to the nearest tier of beams or support, whether this be a foundation, a beam, or a girder.

Thickness of foundation walls, Sec. 17, par. 2 and 3.

Thickness of non-bearing walls, Secs. 27-29.

3. *Walls for Dwelling House Class.* The expression "walls for dwelling house class" shall be taken to mean and include walls for all buildings specified under Classes C and D, Section 11, as well as all other buildings used for temporary or permanent residence.

DIAGRAMS SHOWING RELATION OF ALLOWABLE WALL HEIGHTS TO MINIMUM REQUIRED THICKNESS.

*Brick Walls of
Dwelling House Class.*

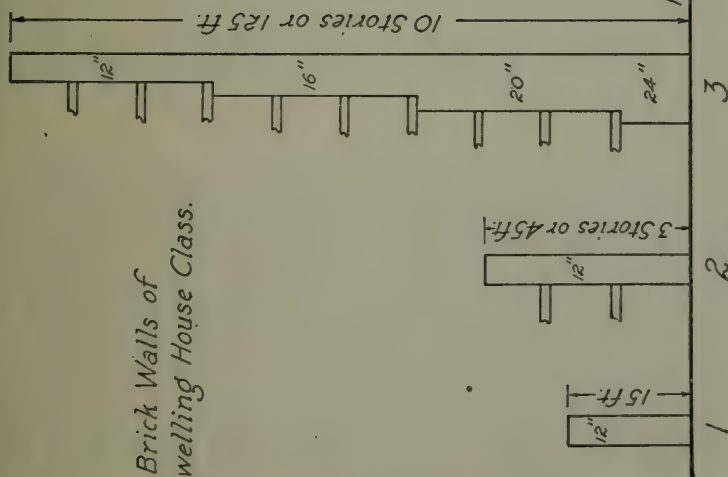


FIG. 1.

1. Maximum height of a single story, 12 inch wall.
2. Maximum height of a 12 inch bearing wall.
3. Minimum thickness of a ten-story bearing wall.

*Brick Walls of
Warehouse Class.*

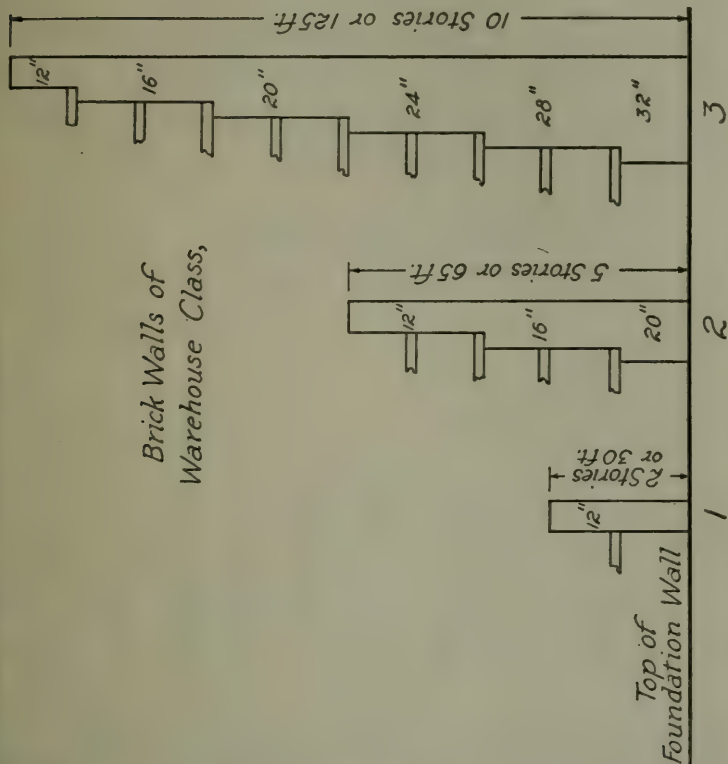


FIG. 2.

1. Maximum height of a 12 inch bearing wall.
2. Minimum thickness of a bearing wall not exceeding five stories in height.
3. Minimum thickness of a ten-story bearing wall.

For all brick bearing walls of buildings of the dwelling house class, the upper three stories shall be not less than 12 inches thick, increasing 4 inches in thickness for each three stories or fraction thereof below. No three-story increment shall exceed 45 feet in height. See Fig. 1.

4. Table indicating minimum thickness of walls in accordance with above requirements:

Dwelling House Class.

Brick Bearing Walls.

Stories	1	2	3	4	5	6	7	8	9	10
1.....	12	..	..	..	..	..	..	..	..	..
2.....	12	12	..	..	..	..	..	..	..	..
3.....	12	12	12	..	..	..	..	..	..	..
4.....	16	12	12	12	..	..	..	..	..	..
5.....	16	16	12	12	12	..	..	..	..	..
6.....	16	16	16	12	12	12	..	..	..	..
7.....	20	16	16	16	12	12	12	..	..	..
8.....	20	20	16	16	16	12	12	12	..	..
9.....	20	20	20	16	16	16	12	12	12	..
10.....	24	20	20	20	16	16	16	12	12	12

5. *Walls for Warehouse Class.* The expression "walls for warehouse class" shall be taken to mean and include walls for all buildings specified under Classes A, B, E, and F, in Section 11, as well as all other buildings used for similar purposes.

Excepting party and fire walls, brick bearing walls for all buildings of this class, not exceeding five stories or 65 feet in height, shall have the upper two stories not less than 12 inches thick, increasing 4 inches in thickness for each two stories or fraction thereof below. For such building in excess of five stories, but not exceeding ten stories or 125 feet in height, the top story shall be not less than 12 inches thick, increasing 4 inches in thickness for each two stories or fraction thereof below. No two-story increment shall exceed 30 feet in height. See Fig. 2.

6. Table indicating minimum thickness of walls in accordance with above requirements:

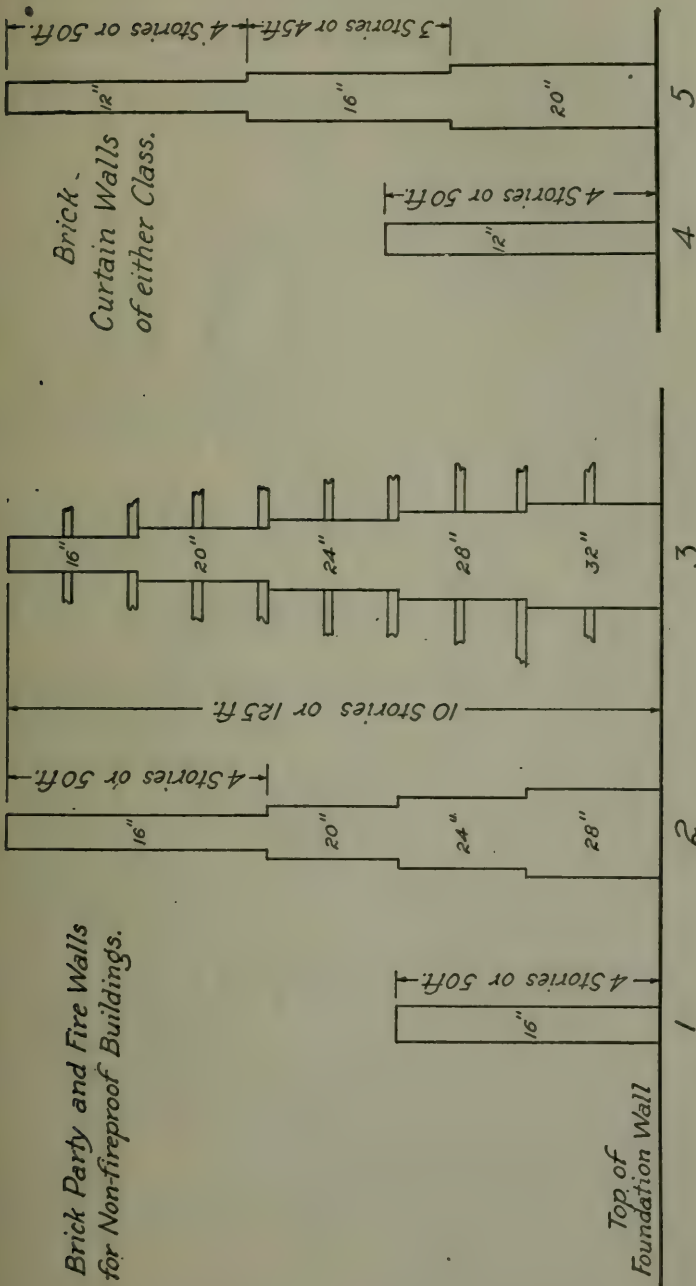


FIG. 3.

1. Maximum height of a 16-inch party or fire wall.
2. Minimum thickness of a ten-story non-bearing party or fire wall.
3. Minimum thickness of a ten-story bearing party or fire wall.

4. Maximum height of a 12-inch curtain wall.
5. Minimum thickness of a ten-story curtain wall.

Warehouse Class.

Brick Bearing Walls.

Stories	1	2	3	4	5	6	7	8	9	10
1.....	12	..	..	..	..	..	..	..	..	..
2.....	12	12	..	..	..	..	..	..	..	..
3.....	16	12	12	..	..	..	..	..	..	..
4.....	16	16	12	12	..	..	..	..	..	..
5.....	20	16	16	12	12	..	..	..	..	..
6.....	24	20	20	16	16	12	..	..	..	..
7.....	24	24	20	20	16	16	12	..	..	..
8.....	28	24	24	20	20	16	16	12	..	..
9.....	28	28	24	24	20	20	16	16	12	..
10.....	32	28	28	24	24	20	20	16	16	12

NOTE.—The thicknesses here given as 12, 16, and 20 inches, etc., are in some parts of the country designated as 13, 17, and 21 inches, etc. They are to be considered as equivalents.

7. In all buildings, except dwellings, brick party walls and fire walls which serve as bearing walls on both sides, shall be not less than 16 inches thick in the upper two stories or upper 30 feet, increasing 4 inches in thickness for each two stories or fraction thereof below. See Fig. 3, (3).

Thickness of non-bearing fire walls, Sec. 29, par. 1.

8. The height of a wall between lateral supports shall not exceed fifteen times its thickness unless strengthened by piers or cross walls, as the Superintendent may direct.

9. When the clear span of a floor is greater than 25 feet in buildings of Classes A, B, E, and F, and greater than 26 feet in buildings of Classes C and D, the thickness of bearing walls shall be increased 4 inches over that specified in the foregoing tables for every $12\frac{1}{2}$ feet or fraction thereof that the said span exceeds 25 feet for buildings of Classes A, B, E, and F, or 26 feet for Classes C and D; or shall have in lieu of this increase of thickness, such piers or buttresses as the Superintendent may direct.

Classification of buildings, Sec. 11.

10. Every bearing wall faced with brick laid in running bond shall be 4 inches thicker than specified in the foregoing tables.

11. If any horizontal section through a bearing wall shows more than 30 per cent. area of flues and openings in

a wall laid up in lime, or lime and cement mortar, or 45 per cent. in a wall laid up in Portland cement mortar, the said wall shall be increased a thickness of 4 inches for every 15 per cent. or fraction thereof for which the total area of flues and openings exceed 30 per cent. or 45 per cent. The total area of openings and flues in any bearing wall shall not in any case exceed 60 per cent.

12. In all buildings, walls 12 inches thick, and over 60 feet in length; and walls 16 inches thick which are over 100 feet in length, shall be 4 inches thicker throughout than is required by this Code, unless they are properly braced by cross walls, pilasters, or buttresses.

NOTE.—It is well known that many masonry walls are thrown down or ruined during a fire by the expansion produced by heat. The requirements of paragraph 12 are based upon this fact.

13. The thickness of non-bearing walls may be 4 inches less than that of bearing walls, provided that no non-bearing wall is less than 12 inches thick except it be of reinforced concrete.

Partition walls, Sec. 115.

Shaft walls, Sec. 90.

14. In no case shall the thickness at the bottom of masonry retaining walls be less than one-quarter the height of the wall unless reinforced in an approved manner.

15. Brick or concrete walls of buildings outside the fire limits, which under this ordinance could be of wood, may have a minimum thickness of 8 inches. Such walls shall not exceed two stories or 30 feet in height, exclusive of gables, nor shall they exceed 55 feet in length unless properly braced by cross walls, piers, or buttresses.

Section 27. Panel or Enclosure Walls for Skeleton Construction. In skeleton construction the panel walls shall be supported by girders at each floor level, and if of brick or hollow blocks, shall be not less than 12 inches thick, laid in cement mortar. When the vertical distance between supporting girders exceeds 15 feet the thickness of the wall shall be increased 4 inches for each 15 feet or fraction thereof that the said vertical distance exceeds 15 feet. Such walls shall be of brick, stone concrete, or hard burned building tile. See Sec. 31, par. 8.

Reinforced concrete walls, Sec. 147.

Section 28. Curtain Walls. Curtain walls over three stories or 50 feet in height shall be laid in cement mortar, and shall be not less than 12 inches thick for the uppermost 50 feet thereof, or nearest tier of beams to that height, and increased 4 inches for every additional section of three stories or 45 feet, or nearest tier of beams to that height. When such walls are used, the foundation of the buildings shall be so designed that the load from the columns and the load of the walls are carried together. Curtain walls shall be anchored to the steel framing at each floor level, the anchors being spaced not further apart than 6 feet horizontally. See Fig. 3, Nos. 4 and 5.

Section 29. Fire Walls.

1. Fire walls shall be built of brick laid in Portland cement mortar, or of reinforced concrete. In fireproof buildings, brick fire walls supported by girders at each story, may be 12 inches thick throughout. In non-fireproof buildings, brick fire walls which do not serve as bearing walls shall be not less than 16 inches thick in the upper four stories or upper 50 feet, increasing 4 inches in thickness for each two stories or fraction thereof below. See Fig. 3. No such two-story increment shall exceed 30 feet in height. In frame buildings used for manufacturing or commercial purposes, and not exceeding two stories or 30 feet in height, non-bearing fire walls shall not be less than 12 inches thick.

Thickness of fire walls serving as bearing or party walls, Sec. 26, par. 7.

Thickness of reinforced Concrete Walls, Sec. 147.

2. Every opening in a fire wall or a party wall, shall be protected on each side of the wall by an approved automatic fire door. No opening in any such wall shall exceed 80 square feet in area, except that by written permission of the Superintendent, an opening not exceeding 120 square feet may be allowed in special cases. Only doors approved for such over size openings shall be used to protect them. In no case shall the total width of openings in any one story, other than the first story, exceed 25 per cent in linear length of the wall. Fire and party walls shall be continuous from foundation to 3 feet above roof level and be coped, except that such walls in fireproof buildings need not extend above the top of the roof beams.

3. When three or more buildings used for stores, factories or warehouses, communicate by openings through separating fire walls, the openings shall be protected by double fire doors, and each building shall also be provided with a system of approved automatic sprinklers.

NOTE.—The great value of solid walls in restricting the spread of fire is so well known, argument should be unnecessary to insure their use wherever suitable. A fireproof factory or warehouse with properly restricted areas between fire walls, equipped with automatic sprinklers, and having proper protection to vertical openings and windows, would be practically impossible to burn. The truth of this statement has been demonstrated many times. The folly of building otherwise is a self-evident verity.

Fire walls are as useful in protecting school buildings, hospitals, hotels, state and county buildings, large residence buildings, and in fact any building having considerable area, as they are in other types of buildings. In such public buildings where numerous people are housed, many of whom may be invalids or infirm, the life saving features of properly constructed fire exits through fire walls, cannot be over-estimated. The additional expense of such cut-offs is slight, and neither the architectural effects, nor the utility of the building, need be affected by their introduction. Necessary openings in such walls when not large, can be efficiently protected by fire doors as artistic in finish as ordinary doors. It is no longer necessary to be restricted to the unsightly tin clad fire door for such use.

Fire exit partitions, Sec. 47.

4. If an opening in a fire wall is made to serve as an emergency or horizontal exit, and is included in the calculations for exits, it shall not exceed 48 square feet in area, and a self-closing fire door shall be substituted for one of the automatic fire doors. The automatic door shall be controlled by an approved automatic door release on each side of the wall.

NOTE.—A *self-closing fire door* is one which is normally kept in a closed position by some mechanical device.

An *automatic fire door* is one which is arranged to close when released by the action of heat.

Self-closing fire doors used on exit openings in fire walls, should have a standard of quality at least equal that required for stairway doors. Such doors are intended to prevent the passage of smoke through the opening, which might under certain conditions, render an adjoining floor area untenable before the heat would be sufficient to close the automatic door. For this reason the self-closing door should never be allowed to be held open mechanically for more than a few minutes at a time when strictly necessary for transporting goods through the doorway or for similar service. Under no circumstances should it be held open by a mechanical device other than one which contains a fusible link as an integral part. Such device shall be attached at the top of the door.

If other openings in a fire wall communicate directly with an area of refuge included in the calculations for exits and protected by a self-closing fire door as above described, the automatic fire doors protecting such openings should be kept closed at all times except for short periods when strictly necessary for the transportation of goods.

Horizontal exits, as emergency exits, Sec. 46, par. 2, (c).

Section 30. Parapet Walls. All exterior or party walls over 20 feet high, except where such walls are finished as cornices, gutters, or crown mouldings, excepting also the walls of detached dwellings with peaked or hipped roofs, shall be furnished with parapets. Parapet walls shall be the full thickness of the top story walls, and shall project at least 3 feet above the roof at all points, except that on dwellings the parapets may be reduced to 2 feet. All parapet walls shall be coped with approved durable material.

Parapets on fire walls, Sec. 29, par. 2.

Mortar for parapets, Sec. 25.

Section 31. Hollow Building Block Walls.

1. Hollow building blocks of hard burned clay or of concrete, may be used for all walls, except party and fire walls, of buildings not exceeding three stories or 40 feet in height, provided that such blocks have met the test requirements of Section 58, and are not stressed beyond the safe limits therein prescribed. The minimum thickness of such walls shall be as required for brick walls.

Thickness of walls outside fire limits, Sec. 26 par. 15.

Hollow blocks for skeleton construction, par. 8.

Building block defined, Sec. 58, par. 1.

2. Concrete blocks shall not be used in construction until they have attained an age of 28 days, nor until they have developed the required test strength. All building blocks shall be laid in Portland cement mortar.

3. If a wall be built of blocks laid with the cells horizontal, which were designed to be normally laid with the cells vertical, or if band courses of such blocks with cells horizontal be laid in a wall otherwise built of the same blocks with the cells vertical, the carrying capacity of such walls shall be calculated from the strength of the blocks tested with their cells horizontal.

Test requirements for hollow building blocks, Sec. 58.

4. Hollow building tile blocks in exterior walls shall be either extra hard burned or be veneered with brick, architectural terra cotta, or stone, securely bonded and set as provided in Section 21, paragraph 8, or the blocks shall be covered on the exposed surface with at least $\frac{3}{4}$ inch of Portland cement stucco; such blocks shall be well scored, grooved or roughened to retain the coating. The stucco shall not be considered as a part of the required thickness of the wall.

5. When hollow block walls, laid with cells vertical, are decreased in thickness, the blocks in the top course of the thicker wall shall be filled solidly with concrete, or the exposed openings in such top course may be covered with slabs of hard burned tile or concrete at least 1 inch in thickness. Tile, concrete, or metal slabs or templates of approved size and thickness shall be placed under all floor beams and girders as bearing plates in order that the allowable working stresses shall not be exceeded.

Hollow blocks filled with concrete, Sec. 58, par. 10.

6. Building blocks shall be so laid that the shells and webs shall be superposed upon the shells or webs of the adjacent block or blocks below.

7. Hollow blocks when used to form lintels, which are not keyed arches, shall be reinforced with steel rods, and be filled solidly with concrete. Such lintels shall be designed in accordance with the unit stresses and other requirements for reinforced concrete as required in Section 117, etc.

8. Except for party or fire walls, hard burned hollow tile blocks may be used for walls of skeleton construction having a height not exceeding four stories or 55 feet. The thickness shall be the same as required for brick walls.

Hollow tile blocks faced with brick bonded in the manner specified in the last half of paragraph 8, Section 21, may be used for walls of skeleton construction to a height of 10 stories or 125 feet.

Panel walls for skeleton construction, Sec. 27.

Hollow blocks for foundations, Secs. 17 and 189.

NOTE.—It is recommended that hollow building blocks having shells or webs one inch or less in thickness, which are laid with cells vertical in walls which have unusual length or height between

supports, or which are liable to be subjected to stresses which would make them unstable, shall be reinforced by interior metal supports, or that a layer of metal fabric be embedded in each horizontal mortar joint. The fabric to be $\frac{1}{2}$ inch less in width than the thickness of the wall, and to have a mesh $\frac{1}{8}$ to $\frac{1}{2}$ inch. The fabric to be laid in the joint before the mortar is deposited and be lapped at the corners.

Section 32. Existing Walls.

1. Where an existing party wall is to be incorporated in a new building of skeleton or curtain wall construction, the vertical extension of the existing party wall shall be supported entirely by columns and girders and not by the party wall below, except that such existing party wall may be extended vertically to the height permitted by this Code for its existing thickness, if written approval for such extension is given by the Superintendent.

2. Should it be desired to increase the height of other existing party or independent walls, which are less in thickness than required under this Code, this shall be done by lining with brickwork to form a combined thickness with the old wall of not less than 4 inches more than the thickness required for a new wall corresponding with the total height of the wall when so increased in height. Such lining shall be supported on proper foundations and carried up to such a height as the Superintendent of Buildings may require. All linings shall be at least 8 inches in thickness, laid up in cement mortar, bonded with 4 inch by 16 inch brick toothing projecting 4 inches into the old wall at least every 7 feet both horizontally and vertically, and shall be thoroughly anchored to the old brick walls with suitable wrought iron or steel anchors, placed 2 feet apart and properly anchored into the old walls by through bolts or by expansion bolts set in cement or by other approved method. The anchors shall be placed in rows alternating vertically and horizontally with each other, the old walls being first cleaned of plaster or other coatings where any lining is to be built against the same. No wall shall be lined unless in good condition, and then not until written permission so to do has been granted by the Superintendent.

Section 33. Furred Walls and Hollow Walls.

1. The inside 4 inches of all walls may be built of hard burned hollow brick the dimensions of ordinary brick, prop-

erly tied and bonded into the walls. Clay, concrete, or gypsum tile or blocks used as lining or furring shall not be considered as forming part of the required thickness of any wall.

2. In all hollow walls of stone, brick or concrete, the same net horizontal section shall be used as if they were solid. The parts of hollow walls shall be connected by approved ties of brick, stone, or metal, placed not over 24 inches apart horizontally and vertically. Metal ties shall have the ends bent at right angles, and be not less than 1 inch wide by $\frac{1}{4}$ inch thick, and shall extend into the wall on each side not less than 4 inches.

Section 34. Recesses and Chases in Walls.

1. Recesses for stairways or elevators may be located within the required thickness of foundations or cellar walls, provided the walls are not thereby reduced to a less thickness than that required for a fourth story wall. Reinforcement shall be supplied where necessary to compensate for the diminished thickness as approved by the Superintendent.

The brick backing of recesses for alcoves and similar spaces shall be not less than 8 inches thick.

2. No pipe chases shall extend into any wall more than one-third of its required thickness. No horizontal chase shall exceed 4 feet in length in any wall without express permission of the Superintendent. No recess in a wall shall be made within a distance of 6 feet from any other recess in the same wall.

Chases shall not be permitted within the required area of any pier. Chases or recesses in walls built of hollow blocks shall not be formed by cutting of blocks, or by other method which would impair the strength of the wall.

Neat fitting metal sleeves, or asbestos covering, shall be provided around pipes at each floor level, and the chases at these levels shall be filled with solid masonry for the space of one foot in height.

Section 35. Arches and Lintels.

1. Openings for doors and windows shall have arches or lintels of masonry or metal, which shall have a bearing at each end of not less than 5 inches on the wall. Bearing

plates shall be provided for lintels resting on walls where the span is more than 6 feet. Tie rods shall be used in all arches where necessary to resist the thrust.

Mortar for arches, Sec. 25.

2. On the inside of openings less than 4 feet in width in walls of non-fireproof buildings in which lintels or arches may be less than the thickness of the wall to be supported, timber lintels may be permitted which shall rest at each end not more than 2 inches on any wall, and be chamfered or cut to serve for a rowlock or keyed arch.

Section 36. Walls of Unfinished Buildings. Any building, the erection of which was commenced in accordance with specifications and plans submitted to and approved by the Department of Buildings prior to the passage of this Code, if properly constructed, and in safe condition, may be completed or built upon in accordance with the requirements of law as to thickness of walls in force at the time when such specifications and plans were approved.

PART VII.

HEIGHTS AND AREAS.

Section 37. Height of Buildings.

1. No building, or structure hereafter erected, except church spires, water towers, smoke stacks or chimneys, shall exceed in height two and one-half times the width of the widest street upon which it fronts, nor shall it exceed the following limits:

	Height in Stories	Height in Feet
Frame buildings used for purposes other than dwellings and tenements.....	2	30
Frame dwellings and tenements occupied by not more than two families.....	2½	30
Frame dwellings occupied by not more than one family.....	3	35
Buildings having bearing walls of hollow building tile or concrete blocks.....	3	40
Non-fireproof buildings, ordinary construction	4	55
Non-fireproof buildings, mill construction		
Without sprinklers.....	5	65
With sprinklers.....	6	75

Fireproof buildings used for factories, stores, warehouses or workshops.....	7	85
Fireproof buildings other than factories, stores, warehouses or workshops.....	10	125

2. If a single story building exceeds 30 feet in height the roof shall be constructed entirely of incombustible materials, and all metal framework of same shall be protected with fireproofing, except as provided in Section 11, paragraph 2.

3. A single story building not exceeding 30 feet in height may have a roof monitor not exceeding 10 feet in height.

Definition of height, Sec. 7, par. 36.

Effect of pent houses on height, Sec. 83, par. 3.

Pent houses or superstructures affecting height of tenements, Sec. 277.

Section 38. Allowable Floor Areas.

1. In every building of the character named in this section the maximum area of any floor between fire walls or exterior walls, either without or with a full equipment of automatic sprinklers, shall be as follows:

2. Non-fireproof Construction—

(a). Tenement houses, 3000 sq. ft.

(b). All other ordinary non-fireproof buildings, height not exceeding 55 feet.

Fronting on	Without sprinklers.	With sprinklers, increase of 66-2/3 per cent.
One street.....	5,000 sq. ft.	8,333 sq. ft.
Two streets.....	6,000 sq. ft.	10,000 sq. ft.
Three or more streets...	7,500 sq. ft.	12,500 sq. ft.

(c). Mill construction buildings, height limit 65 and 75 feet.

Fronting on	Without sprinklers.	With sprinklers, increase of 100 per cent.
One street.....	6,500 sq. ft.	13,000 sq. ft.
Two streets.....	8,000 sq. ft.	16,000 sq. ft.
Three or more streets.	10,000 sq. ft.	20,000 sq. ft.

Area of frame buildings, Sec. 188.

3. Fireproof Construction—

- (a). All buildings of Classes A, B, C, and D..... } No restrictions as to area.
 Light and power stations. }
 Office buildings..... }
- (b). All other buildings not exceeding 65 feet in height.

Fronting on	Without sprinklers.	With sprinklers. increase of 66-2/3 per cent.
One street.....	10,000 sq. ft.	16,666 sq. ft.
Two streets.....	12,000 sq. ft.	20,000 sq. ft.
Three or more streets..	15,000 sq. ft.	25,000 sq. ft.

- (c). Stores, warehouses, factories, and workshops not exceeding 85 feet; and other buildings not exceeding 125 feet in height.

Fronting on	Without sprinklers.	With sprinklers, increase of 50 per cent.
One street.....	7,500 sq. ft.	11,250 sq. ft.
Two streets.....	10,000 sq. ft.	15,000 sq. ft.
Three or more streets..	12,500 sq. ft.	18,750 sq. ft.

- (d). The first floor only of any fireproof building occupied as a store may have an area of 20 000 sq. ft., and if fully protected by approved automatic sprinklers may be increased 50 per cent. or have a maximum area of 30,000 sq. ft.

NOTE 1.—It is generally conceded that five stories is the maximum height to which water can be thrown effectively by a fire department from the street level, and that 50 feet is the maximum distance inside a building which can be reached by a stream through a window. These facts have been a governing consideration in the establishment of the limits of heights and areas in this Code. In addition, the width of the street upon which a building fronts and the height of the building should be considered; a building endangers adjacent property in proportion to its size and proximity to other property.

The term street as here used, is a public thoroughfare at least 20 feet wide.

The areas given in this section are based upon an average street width of 60 feet. For less than this width, it does not appear unreasonable to require sprinklers for even smaller areas than herein given, particularly for buildings over two stories high. This could well be placed in the hands of the Chief of the Fire Department.

NOTE 2.—Attention is called to a paper entitled "Allowable Heights and Areas for Factory Buildings," distributed by the National Board of Fire Underwriters, which contains a digest of opinion of over a hundred prominent Fire Chiefs upon this subject.

PART VIII.

ALLOWABLE LOADS.

Section 39. Floor Loads.

1. Each floor of every building shall be of sufficient strength in all its parts to bear safely the weight to be imposed thereon, in addition to the weight of the floor itself. It shall safely support a minimum live load per square foot of area as specified in the following table:

Class of building.	Live loads.	
	Pounds per Square Foot. Ground and lower floors.	Upper floors.
Foundries, light and power plants, printing and lithographing houses, railroad freight depots.....	250	250
Warehouses	200	200
Car barns, garages.....	150	120
Fire houses.....	150	60
Armories, ball rooms, dance halls, exhibition buildings, factories, gymnasiums, work shops, lofts, markets, stables, stores, public halls, restaurants.....	120	120
Railway passenger stations.....	120	90
Office buildings.....	120	75
Court houses.....	100	100
Churches, libraries, museums, theatres...	90	90
Schools and colleges.....	90	75
Asylums, bath houses, club houses, detention buildings, dormitories, hospitals, hotels, lodge rooms, lodging houses, studios.....	90	60
Tenement houses and dwellings.....	60	40

Definition of live load, Sec. 7, par. 41.

2. Any floor beam in a building of Class E shall be capable of sustaining a live load at its center of at least 4000 pounds.

3. No safe shall be placed on a stair landing or in a stair hall, nor shall its weight be carried by any beam which also carries the floor of any stair landing or stair hall.

Stair, and stair-landing loads, Sec. 45, par. 2.

Section 40. Roof Loads. Every roof with a pitch of less than 20 degrees with the horizontal, shall be proportioned to bear safely a live load of 50 pounds per square foot of surface. If the pitch be more than 20 degrees, the live load shall be assumed to be 30 pounds per square foot measured on a horizontal plane.

NOTE.—The live loads given in this section include a snow load of 10 pounds. In sections of the country where snow-falls are heavy, due allowance should be made for the additional weight on roofs having a slope of less than 45 degrees.

Roofs having a slope less than 20 degrees are always liable to accidental loading, such as groups of moving people, storage of material, erection of signs, etc. Hence the necessity for moderately large unit loads in design.

Section 41. Column Loads.

1. Every column, post or other vertical support shall be of sufficient strength to bear safely the combined live and dead loads transmitted to it.

Columns eccentrically loaded, Sec. 66, par. 5.

2. In buildings more than five stories in height, the following reductions are permissible: For columns supporting roof and top floor, no reduction; for columns supporting each succeeding floor, a reduction of 5 per cent of the total live load per floor may be made, but the total deduction shall not exceed 50 per cent.

3. No reduction of live load on columns shall be permitted in buildings where the assumed floor load is more than 120 pounds per square foot and is likely to be permanent in character, as in warehouses, printing houses, machine shops, etc.

4. For structures carrying machinery, such as cranes, conveyors, printing presses, etc., at least 25 per cent shall be added to the stresses from live loads to provide for effect of impact and vibrations.

Section 42. Sidewalk Loads. For sidewalks between the curb and building lines, live loads shall be taken at 300 pounds per square foot or a concentrated load of 5 tons at any point.

Section 43. Strength of Existing Floors to be Computed. In every existing building of Classes E and F, erected and occupied before the adoption of this Code, the

weight that each floor will safely sustain shall be computed by a competent person employed by the owner or occupant. Such computations shall be filed in the Bureau of Buildings with an affidavit by the person making the same, in such manner as the Superintendent may direct, and shall give full information on which the computations are based. When the safe live loads on any existing floor thus ascertained has been approved by the Superintendent, he shall post one or more copies of such approved live load in such conspicuous place or places on each story as may be designated by the Superintendent, and no floor shall be loaded in excess of the safe allowance mentioned in said posted copy.

Classification of buildings, Sec. 11.

PART IX.

MEANS OF EGRESS.

Section 44. Number and Width of Exits and Doors.

1. Every building, except dwellings, and every story in each building above the first, shall have at least two means of exit remote from each other; one of these shall open to a street or fireproof passage leading to a street, and one may open to a yard or other space deemed safe by the Superintendent and of sufficient area to accommodate all persons in the building. Two means of exit remote from each other shall be provided from each story of dwellings when over 3 stories in height.

2. In every building except buildings of Class D, all required exit doors, including the doors of vestibules, shall open in the direction of travel. This requirement shall not prohibit the use of doors which swing both inwards and outwards, nor of sliding or rolling doors in stables, garages, storerooms, and the shipping and receiving rooms of manufacturing, mercantile and industrial buildings, where approved by the Superintendent.

3. When exit doorways have a clear width of at least 40 inches, each, the aggregate widths of such doorways shall be equal to the required width of corridor or stairway served by same. When individual doors are less than 40 inches wide, there shall be one doorway for each 22 inches of required width of corridor or stairway

leading to same. Every doorway shall be at least 28 inches wide in the clear. All passageway exit doors shall swing in the direction of exit travel, except in case of horizontal exits where direction of travel may be indeterminate.

All exit doors leading from rooms having an occupancy of 15 or over, shall open in the direction of exit travel, except in schools where fire drills are organized under control of the teachers.

NOTE.—In schools where pupils are trained in fire drill, it is considered essential that classroom doors should open inwards, as they are better adapted to positive control by the teachers in time of panic. If necessary, a teacher can back against a door and hold it until the pupils are in marching order, and the proper time arrives for them to file out.

4. The opening of one door shall not be permitted to obstruct another, and the arc of opening of doors which open upon stairway landings or platforms shall not reduce the width of the passageway to less than the required width of the stairs.

5. Every room having an occupancy of more than 75 persons shall have at least two doorways remote from each other leading to exits.

6. Hallways or corridors at the street or court level furnishing exit from stairway shall be not less in width than the aggregate width of the required stairways which they serve. Every hallway or corridor which may serve as an exit for 50 or more persons shall have at least 44 inches of width for the first 50 persons and 6 inches additional for each additional 50 persons to be accommodated thereby. This computation shall be based on the number of persons in the story having the largest occupancy served by said corridor.

7. At all times when any loft or space is occupied for manufacturing or mercantile purposes, the fastenings or locks on exit doors shall be such as may be easily opened from the inside without the use of keys.

8. A clearly painted sign marked "EXIT" in letters not less than 6 inches in height, shall be placed over all

exits in the above specified buildings. The elevators shall be provided with similar signs marked "ELEVATOR." Such signs shall be illuminated when necessary by means of artificial lighting. The color of such light shall be green.

NOTE.—It has been customary to designate an exit by a red light, but State and National Safety Organizations have adopted green as the standard color to indicate safety, and red to signify danger. It is therefore consistent that exit signs which betoken safety, should be marked by green lights.

9. Elevators, escalators and revolving doors shall not be considered in calculating exit requirements.

10. Entrances and doors in tenement houses, theatres, motion picture theatres, and places of public or private entertainment, shall be as elsewhere provided in this Code.

Tenements, Secs. 284 and 285.

Theatres, Secs. 196-254.

Moving picture theatres, Sec. 255.

Assembly halls, Sec. 256.

Section 45. Stairs and Stairways, Construction of.

1. All buildings which are used above the first floor for manufacturing or business purposes, or for public assemblage, or for any purpose whatever if over three stories or 40 feet high, except armories, court houses, dwellings, fire houses, jails, libraries, museums, police stations, prisons, railway stations, and similar buildings, shall have the required stair shafts separately and continuously enclosed as specified in Sections 90 and 93. In fireproof buildings all stairs, platforms, landings, and stair hallways, including the flooring, shall be of fireproof construction. Storage of combustible material is prohibited within the stairway enclosure.

Enclosure for stair hallways, same as stair shaft.
Sec. 115, par. 7.

2. All stairs, platforms, landings, balconies and stair hallways, shall be of sufficient strength to sustain safely a live load of not less than 100 pounds per square foot for interior construction, and 150 pounds per square foot for exterior construction, with a factor of safety of 4 in each

case; and except in dwellings shall conform to all the requirements of this section as to hand rails, newels, landings, widths, exits, and prohibition against winding treads. The space beneath any stairway built in whole or in part of combustible material shall be left entirely open or be completely enclosed without door or other opening.

3. No stories in any building shall be connected by an open shaft or stairway except dwellings and buildings mentioned in paragraph 1; also theatres as provided in Section 224.

4. Stairways used as required means of exit shall be at least 44 inches wide between faces of walls, or 40 inches wide between face of wall and an open balustrade, or between two open balustrades. All such widths shall be clear of all obstructions except that hand rails attached to walls may project not more than $3\frac{1}{2}$ inches within them, or stringpieces more than $2\frac{1}{2}$ inches. If newels project above tops of rails, a clear width of at least 44 inches shall be provided between the faces of the newel and the face of the wall or newel opposite. All stairs shall have walls or well secured balustrades or guards on both sides, and except in dwellings, shall have hand rails on both sides. A stairway of 7 feet or more in width shall be provided with a continuous intermediate hand rail substantially supported. All stairs shall have treads and risers of uniform width and height throughout each flight; the rise shall be not more than $7\frac{3}{4}$ inches, and the tread exclusive of the nosing not less than $9\frac{1}{2}$ inches. Stairways exceeding 12 feet in height shall have an intermediate landing.

NOTE.—For stairways in primary schools it may be advisable to reduce the height of risers here given.

Buildings in which there may be a congregation of people for civic, political, educational, religious or amusement purposes, except as provided for theatres in Section 221, and in those used for the care or treatment of persons, all stairs exceeding 8 feet in height shall have an intermediate landing. All landings shall be at least 3 feet in length.

5. No arrangement of treads known as winders shall be permitted in required stairways between the level of the top floor and the street, excepting in public and other special buildings where the use and arrangement is approved by the Superintendent.

6. Whenever the treads or landings are of slate, marble, stone or composition, they shall be supported for their entire length and width by a solid metal plate at least $\frac{1}{8}$ inch thick, securely fastened. If stairs are of incombustible material, other than metal, and treads and landings are each solidly supported for their entire length and width by masonry, metal supports for treads may be omitted.

NOTE.—Slate and marble disintegrate quickly when attacked by severe heat. Many accidents have happened to firemen and others by breaking of such treads at time of a fire.

7. All stairways that serve as required means of exit for one or more of the upper four stories of every building shall be continued their full width to the roof, and shall lead by a direct line of travel to the first story, and open directly on the street, or to an open-air or fireproof passage leading to the street, or to a yard or court connected with the street. Such fireproof passage shall be not less than 7 feet in height.

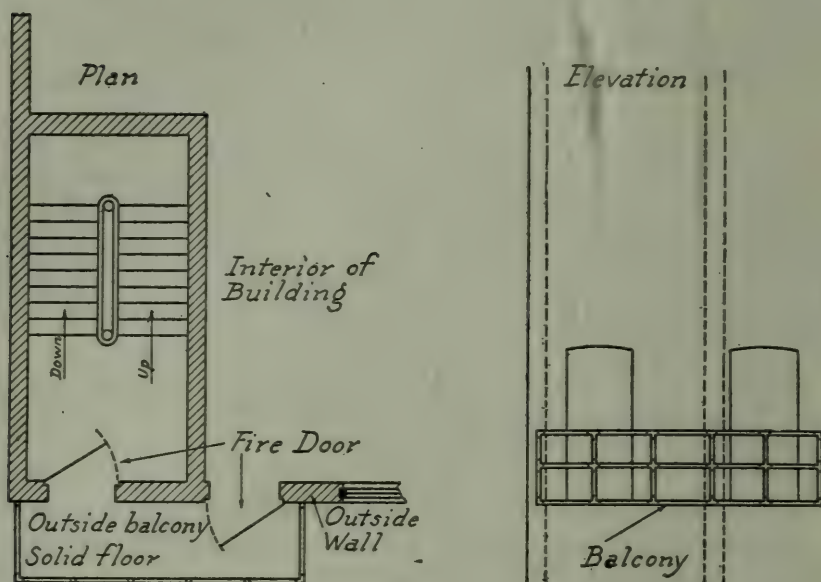
8. The continuity of all stairs which may be used for exit purposes, shall be interrupted at street level by partitions or doors or other means which will indicate the main floor level and make clear the direction of egress to the street.

NOTE.—The purpose of this is to prevent trapping in the basement or cellar of people who are trying to escape to the street.

9. Every enclosed stairway shall be provided with an adequate system of lighting, arranged to insure reliable operation when through accident or other causes the regular lighting is extinguished.

10. All required stairways shall be constructed in one of the following three ways, and shall be known as stair exits:

Smokeproof Tower with Outside Balcony Entrance



Smokeproof Tower with Vestibule Entrance

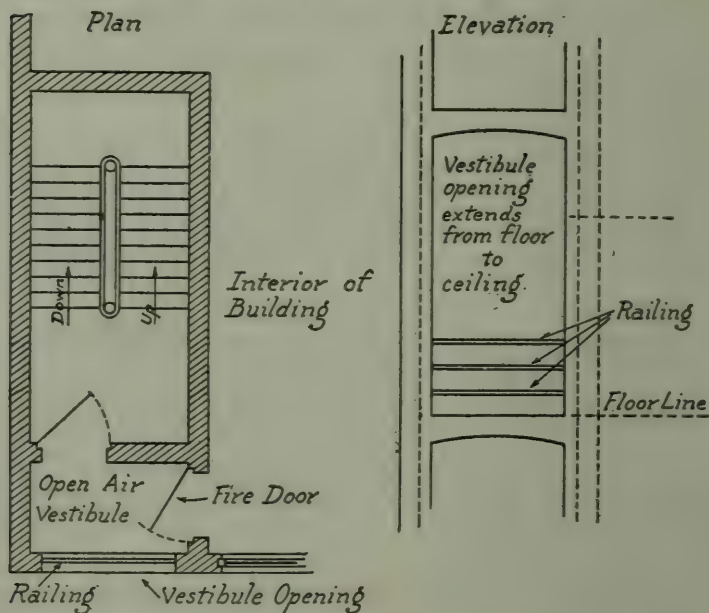


FIG. 4.

Diagrams showing different arrangement for smoke-proof towers. No direct communication with building.

(a) *Enclosed Interior Stairways.* The stairs, landings, platforms, and passageways connected therewith, shall be completely enclosed by fireproof partitions of the standard required in Sections 90 and 93, except that no glass panels shall be permitted in the doors in buildings of Class A not exempted in paragraph 1.

Plan of Smokeproof Tower with Vestibule Entrance Common to Two Buildings

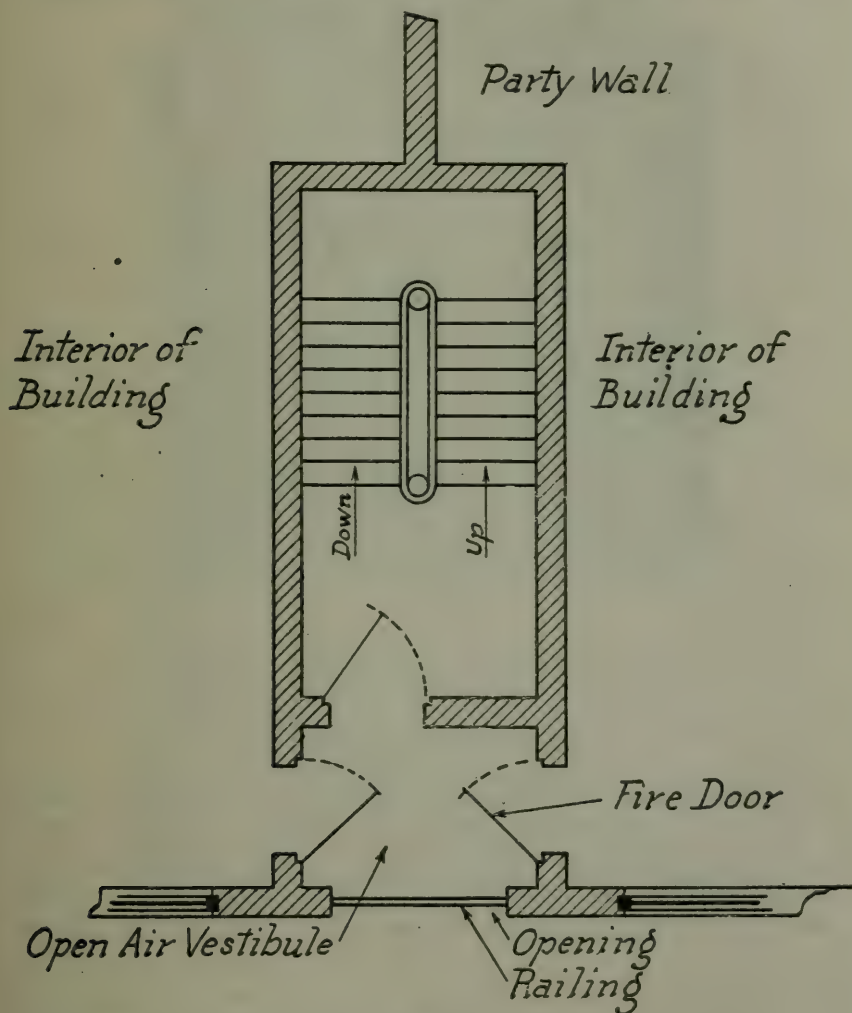


FIG. 5.

Diagram of smokeproof tower adapted for use of two adjoining buildings.



FIG. 6.

Smokeproof tower with outside balcony entrance. Note solid platform, an excellent construction. Compare with upper diagrams of Fig. 4.

(b) *Smokeproof Tower.* The stairs, landings, and balconies or platforms, shall be solid and completely enclosed as required for interior stairways in Section 90, and shall extend from the sidewalk, court, or yard level, to and above the roof to form a bulkhead. There shall be no openings in any wall separating the stairway from the building, but fixed or automatic fire-windows sufficient for lighting purposes are not objectionable in the exterior walls, provided they are not subject to fire exposure hazard from the same or nearby buildings. Access shall be pro-

vided to the stairway from every story of the building by outside balconies of steel or masonry, or by vestibules within the walls of the building but open on at least one side. Every such balcony or vestibule shall have an unobstructed width of at least 44 inches, and shall adjoin an open space not less than 1,000 square feet in area. The balcony or vestibule shall be provided with a solid incombustible floor. Railings of steel, or other approved incombustible material, shall be provided not less than 4 feet high. Access to the balcony or vestibule from the building

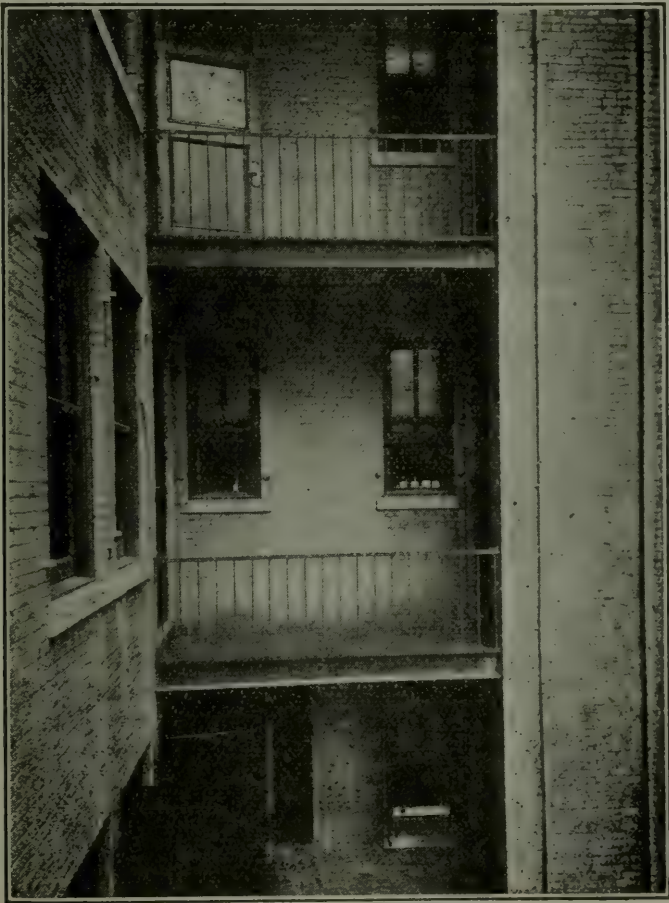


FIG. 7.

Smokeproof tower (on the right) connected to building by open balcony. Arrangement is good, except the windows opening upon the balcony, and the metal grating flooring.

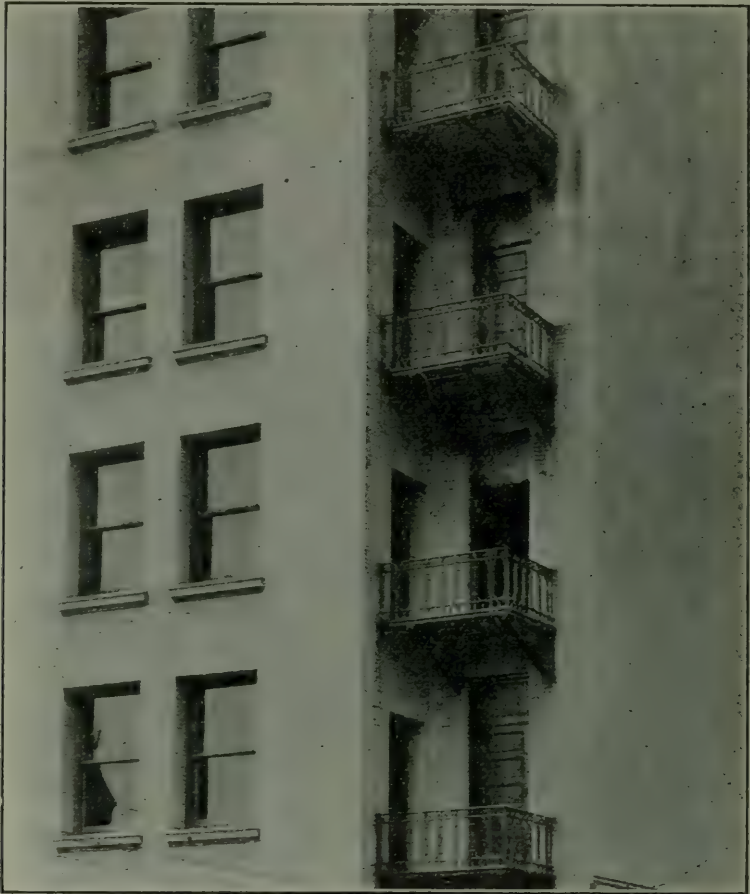


FIG. 8.

An artistic arrangement of a smokeproof tower, which does not disfigure a building.

and to the stairways from the balcony or vestibule shall be by approved self-closing fire doors not less than 40 inches wide and 7 feet high, which shall swing in the direction of exit travel. The doors shall be provided with locks or latches with visible fastenings requiring no keys to open them. A wired glass panel shall be provided in the door opening into the stair shaft of not less than one-third its area. The level of the balcony or vestibule floor shall be not more than $7\frac{3}{4}$ inches below the door sill of the building. Landings in such stairways shall be of a width that the doors in opening into the stairway shall not reduce the free

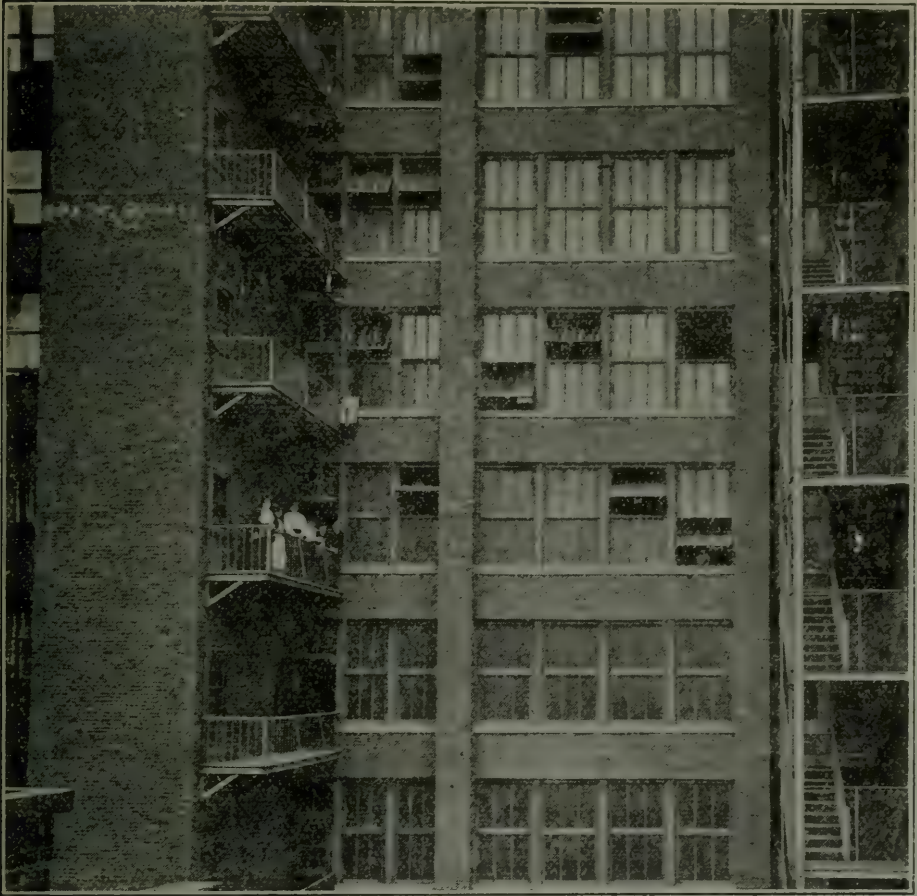


FIG. 9.

An excellent arrangement of two types of approved emergency fire exits communicating to the same building. Smokeproof tower on the left, and outside stairway on the right. Solid floors would be an improvement.

passageway of the landing to a width less than the width of the stairway. Figures 4 and 5 show typical arrangements for smokeproof towers. Figures 6 and 10 are photographs illustrating different architectural treatment of exterior balcony connection to smokeproof towers.

NOTE 1.—It is recommended that the balustrades enclosing the balconies of smokeproof towers be of sheet metal or other suitable solid material. This would give confidence to the timid, and afford valuable protection from smoke and flames issuing from a door or window beneath the balcony.

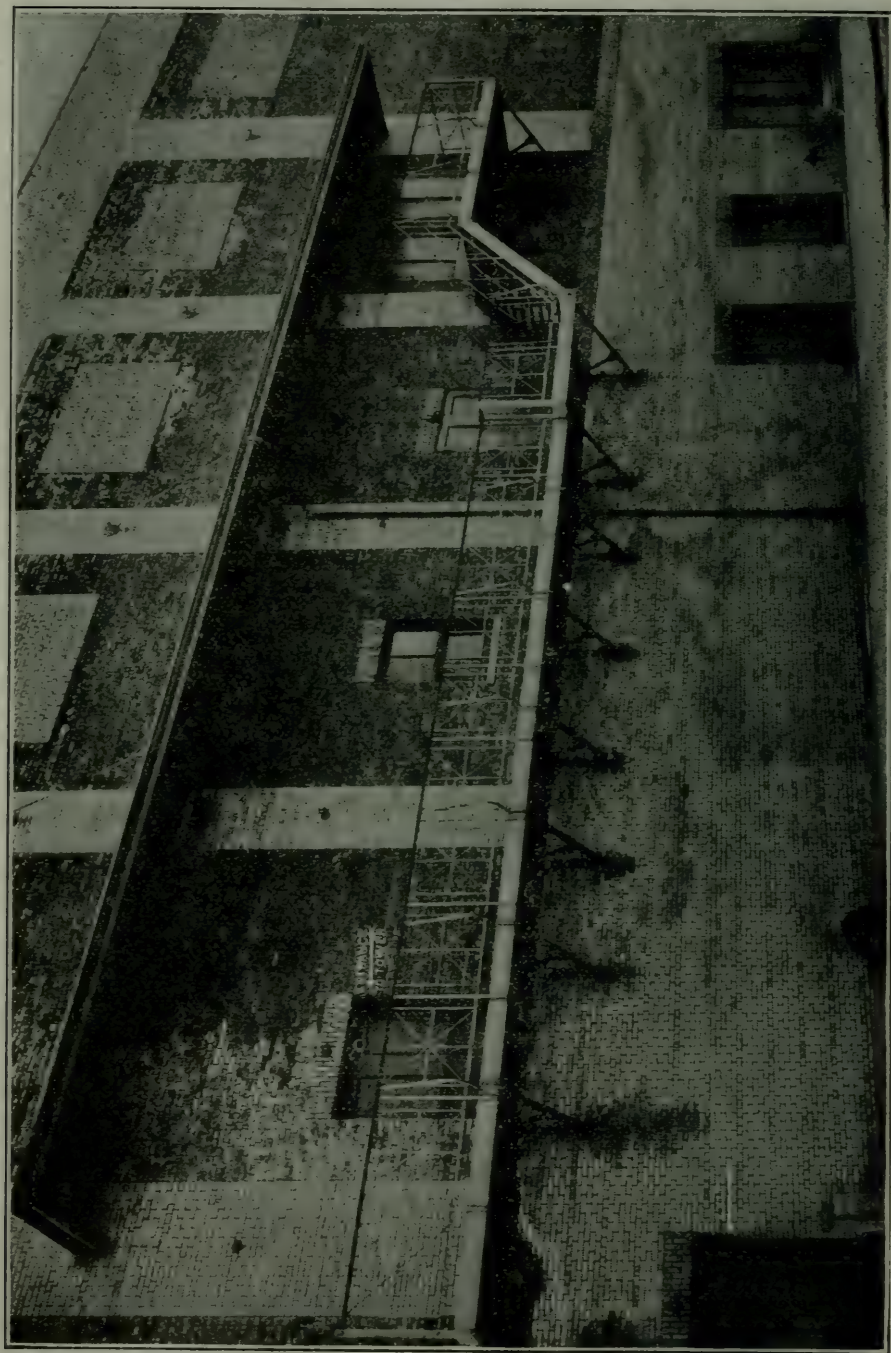


Fig. 10.

Smokeproof tower exit as applied to small theatre. Furnishes safe exit and avoids obstruction of sidewalk.

For the same reasons, the balustrades of outside exit stairways, where directly over or near wall openings, should be enclosed in the same manner.

NOTE 2.—The use of a smokeproof tower or stairway is recommended as one of the best-known means of safe escape from a burning building. At the same time it provides a protected position from which firemen can attack a fire on any floor.

(c) *Outside Exit Stairways.* Such stairs shall be connected to each story by means of an approved self-closing fire door and incombustible balcony. The door shall be not less than 40 inches wide, and the balcony shall be

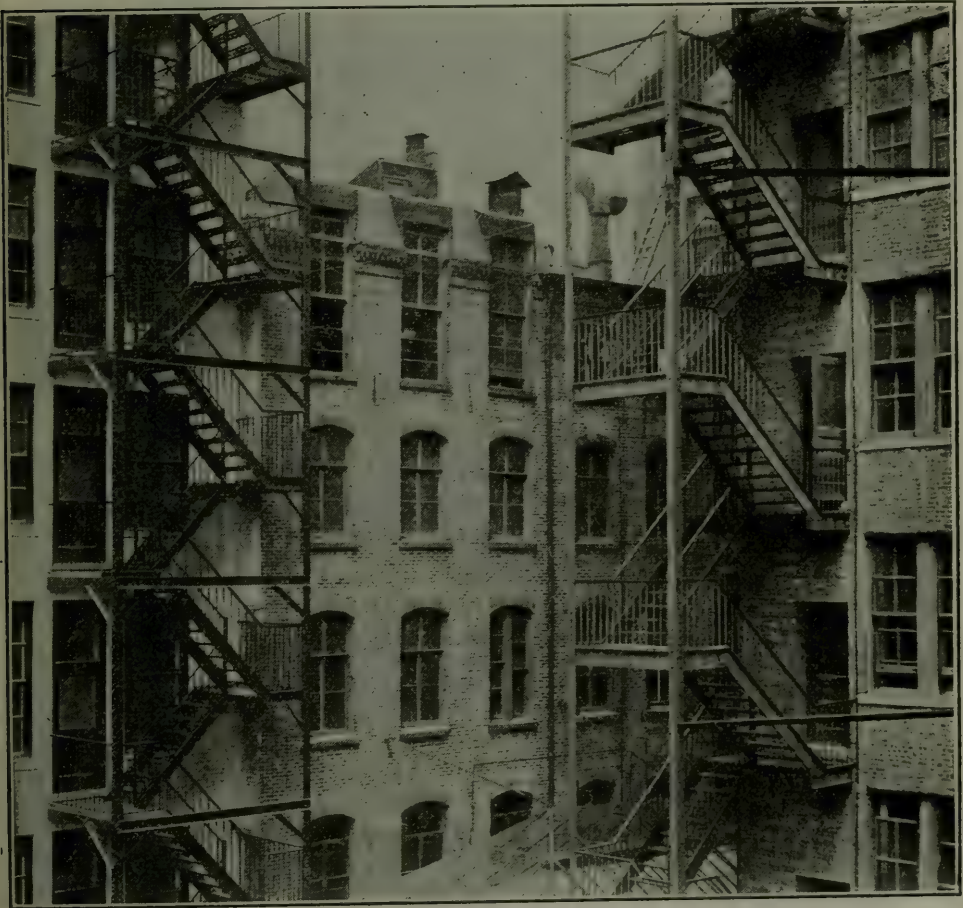


FIG. 11.

Two types of outside exit stairways. One with stair flights parallel, and the other at right angles to the building. The former has the defect of windows facing the stairway. In time of panic, such stairs would be safer if constructed with risers.

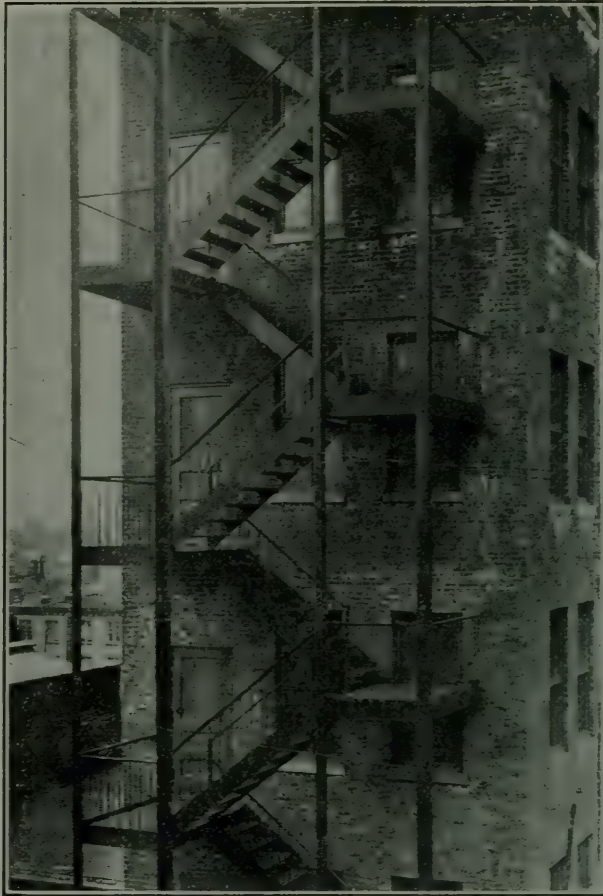


FIG. 12.

Another method of outside exit stairway construction. Compare framing with similar stairway on left of Fig. 11. The windows opening upon both stair flights and landings are a serious defect.

the same width as the stairs. All wall openings within 10 feet of such stairs shall be protected by approved self-closing fire doors on doorways, and automatic or fixed fire windows on window openings. No riser on such stairs shall be nearer than 4 feet to any such wall opening, except to doors giving access to the same. Metal mesh or other rigid guards at least 4 feet high shall be provided on each side of such stairway throughout. Figs. 11 to 15 illustrate different methods of construction. Provisions shall be made to prop-

erly drain the stairs and landings. See Section 74, paragraph 7, for construction requirement.

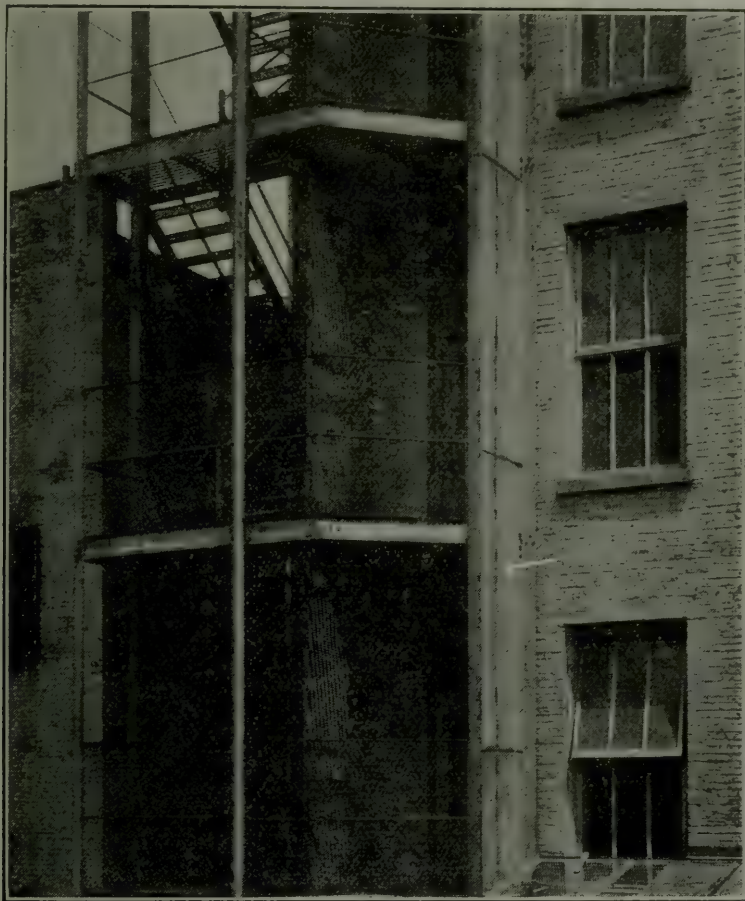


FIG. 13.

Very safe arrangement of outside exit stairway. Arrow indicates a metal guard plate 3 feet wide erected to protect landings from flames that might issue from windows.

NOTE 1.—It is very important that outside exit stairways be so placed that they are not in front of or over windows. Although the windows be protected by wired glass, the heat radiated through them from a fire in the building might easily make it impossible for people to pass, and there is always the added danger of flame and smoke from a window which for some reason is open. If such windows are strictly necessary, the stairway should be set away from the building not less than four feet, as required. Portions of such stairways over or near windows should be made solid, and additional safety for travel in cold and wet weather would be secured by making all treads and landings with non-slipping surfaces.

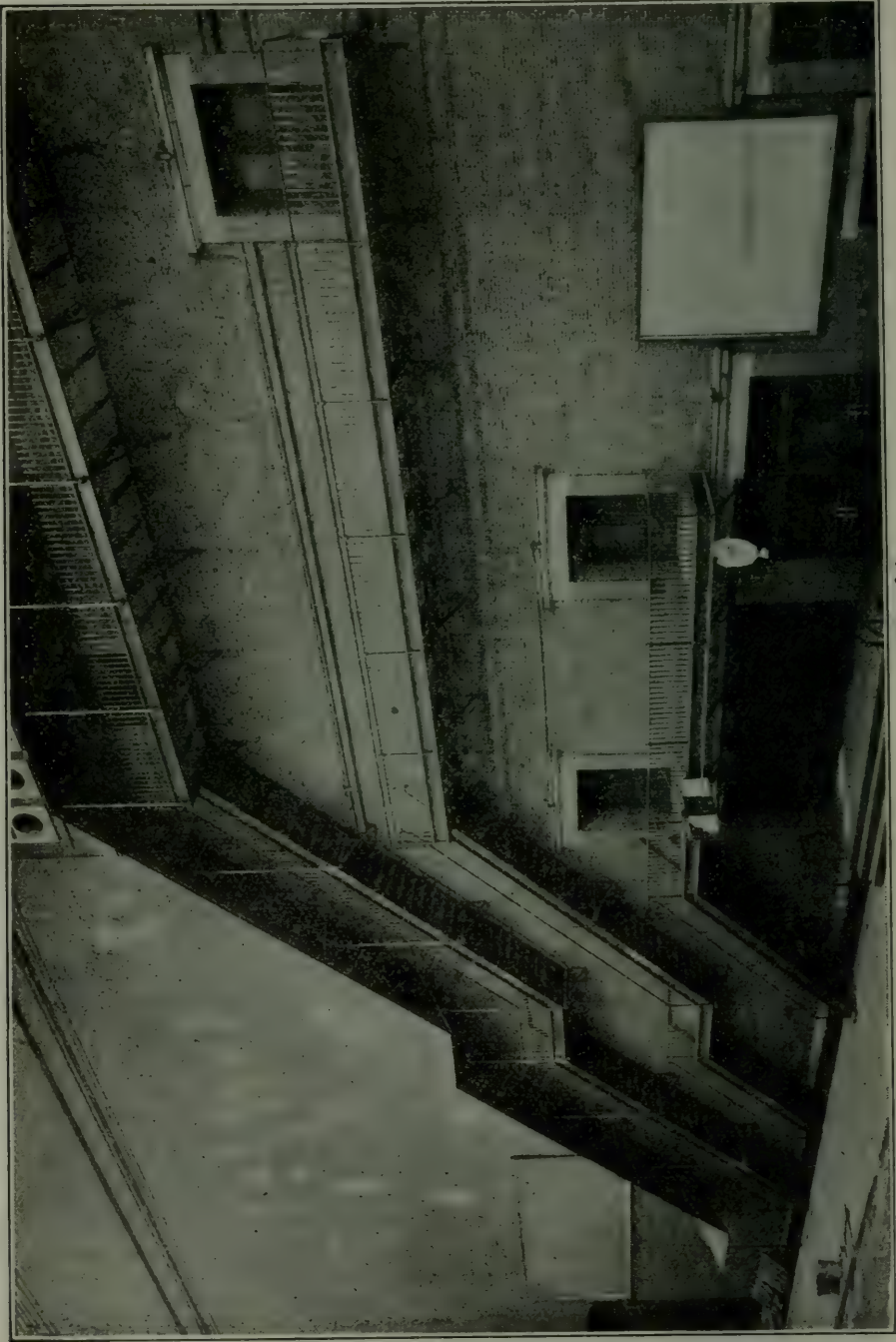


Fig. 14. Outside straight-run stairways as applied to a theatre. Note bracket method of support and protecting hood.

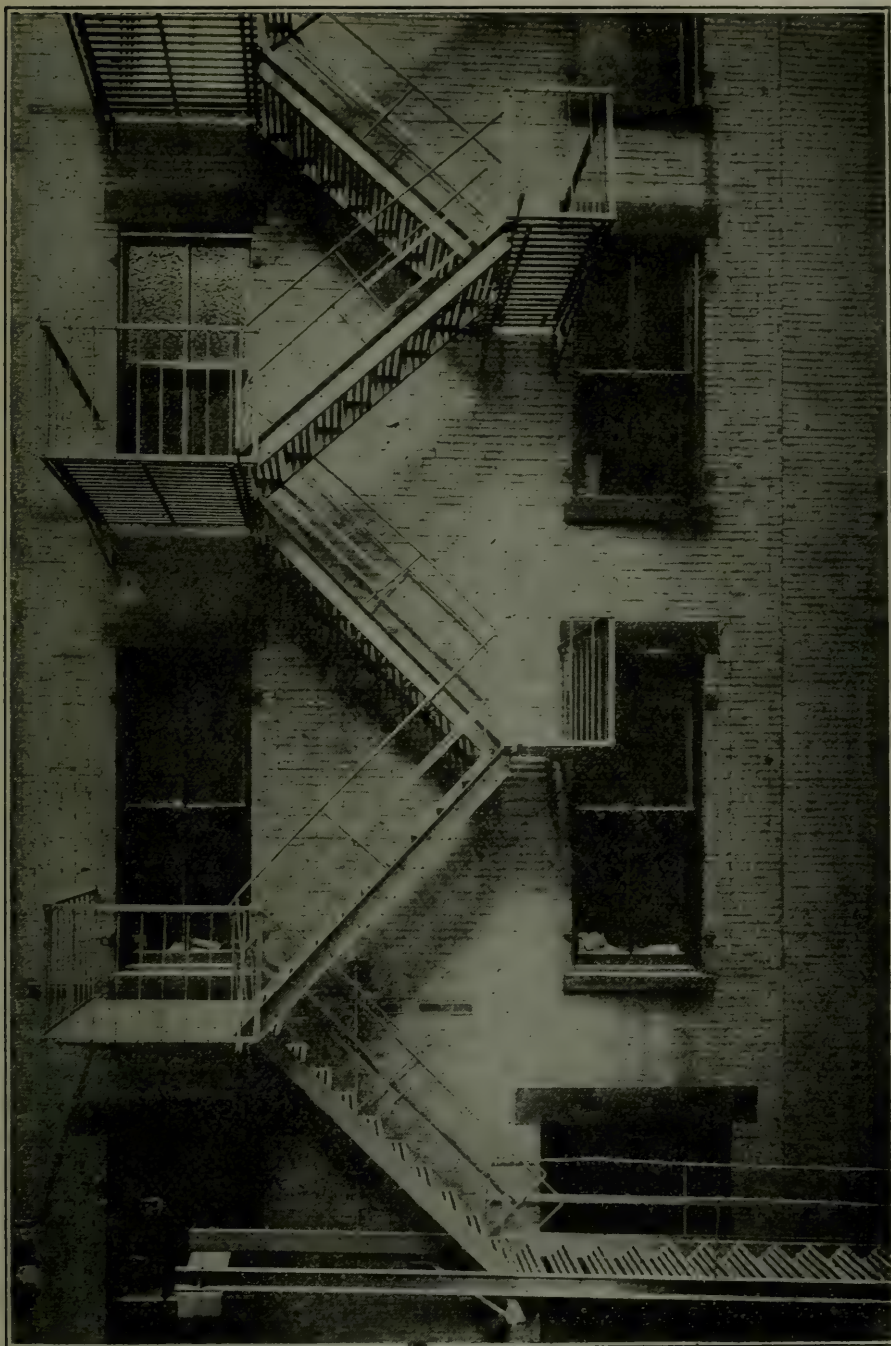


FIG 15.

Outside balconies and stairway with balanced flight at the bottom. Stairways of this type permissible on existing moderate height buildings where occupancy is not large. Windows protected by wired glass in metal frames.

NOTE 2.—The ordinary so-called “fire escapes,” consisting of steel-framed balconies attached to a wall and connected by narrow steel ladders or steps leading from openings in the floors of the balconies, are considered very inefficient and unsafe means of exit. If any considerable number of people attempt to use such an exit in time of fire panic, it quickly becomes so congested that travel is very much impeded or entirely blocked. If fire occurs on the floor below that from which people are endeavoring to escape, and the windows facing such exit are not protected by wired glass, the fire escape is worthless and even with wired glass the exit is of doubtful value because of the intense heat which radiates through the windows. Such means of exit should never be permitted except upon existing buildings, where the number of people to be accommodated by them is small, and where structural conditions are such that it is impossible to secure anything better. They are not recognized as a required means of exit in this Code.

The horizontal exit and the three types of stairways specified in Section 45 are all efficient and safe means of exit. The outside exit stairway is the least desirable of the four, since when wet or covered with ice or snow it is more difficult to travel. A roof over the stairway would lessen this defect. Completely enclosing the stairway would render it nearly as efficient as a smokeproof tower.

Horizontal exit, Secs. 46, par. 2, (c), and 47.

Stairways in tenement houses, Secs. 286-289.

Stairways in theatres, Secs. 214-228.

Section 46. Requirements for Exits and Stairways.

1. Every building hereafter erected, and every building altered or converted to increase its occupancy, excepting dwellings, tenement houses, theatres, and assembly halls, which are elsewhere provided for, shall have exits and stairways as required in this section.

Exits for dwellings, Sec. 44, par. 1.

2. (a) The term *floor area* in this section shall mean the entire space in a given story between exterior walls, fire walls or fire exit partitions, except that in computing such area the space occupied by walls, partitions, columns, and all shafts may be excluded.

(b) The term *stair exit* in this section shall be as required in paragraph 10, Section 45.

(c) The term *horizontal exit* shall be understood to mean one or more openings through or around a fire wall, fire exit partition, or any wall separating two buildings; no such opening shall be less than 30 inches wide: Or such an exit may be an exterior bridge or balcony connecting two buildings or two floor areas of the same building.

Where there is a difference in level between connected buildings or floor areas, gradients shall be provided of not more than 1 foot in 6 feet where practicable. The bridges or balconies shall be not less than 44 inches wide, and shall be constructed of incombustible material, and enclosed on the sides at least 4 feet high. All exterior exposing openings in connected buildings or floor areas within 10 feet of bridge or balcony shall be protected by fire doors or fire windows with fixed or automatic sash. The floor of a bridge or balcony shall not be less than $7\frac{3}{4}$ inches below the door sill opening upon it; the connecting floor within the building shall be not more than 1 inch below the sill. Every such bridge or balcony when enclosed shall be provided with means for lighting.

Fire exit partitions to provide horizontal exits.
Sec. 47.

Fire walls as horizontal exits, Sec. 29, par. 4.

All horizontal exits shall be provided with self-closing fire doors. Such doors shall be kept unlocked during the occupancy of any portion of the floor areas or connected buildings. No glass shall be used in such doors when used on exits through fire walls as provided in Section 29, paragraph 4. Wired glass may be used in doors in other horizontal exits provided it conforms to the requirements of Section 47, paragraph 4.

Requirements for self-closing fire-doors, Sec. 29 par. 4, Note.

The available floor area on each side of a horizontal exit shall be sufficient for the joint occupancy on the basis of not less than 3 square feet of unobstructed space per person, and shall be provided with at least one stairway as defined in Section 45.

NOTE.—As a means of rapid and safe egress from a burning building, the use of horizontal exits through or around a fire wall or a fire exit partition are very strongly recommended. Such an exit would afford an area of quick refuge upon either side. An important feature of the horizontal exit is that it removes necessity for hasty flight down long stairways in case of fire. The physical effort of hurrying down stairs from a height of even eight or ten stories is excessive, especially for those who are not strong. In still higher buildings there is always danger of stairways becoming blocked by people collapsing from exhaustion before reaching the street level. Much of this danger is removed when people know they are safe.

The efficiency of a horizontal exit as a means of escape from fire, is considered three times that of an equal width of stairway. See Note in paragraph 6.

3. (a) In all buildings not exempted in paragraph 1 of this section, one of the two required means of exit from every floor area above the first floor shall be a stair exit, and the other may be a stair exit or a horizontal exit. No part of any floor area above the first floor, excepting buildings of Class F, shall be more than 100 feet distant from an entrance to one such means of exit.

When a building over 35 feet in height is occupied for business purposes on the lower floors and for the home of not more than two families on the floors above, at least one continuous enclosed stairway shall be provided to the street level through the stories occupied for business.

(b) In buildings of Class E, over 55 feet high, except office buildings, one of the two required means of exit shall be either a smokeproof tower or an interior enclosed stairway with self-closing doors opening into hallways which are also enclosed with fireproof partitions as specified in Section 115, paragraph 1.

(c) In every building over 90 feet in height one of the required means of exit shall be a smokeproof tower or a horizontal exit as herein defined.

4. In determining the occupancy of any building, the width of stairways required for any floor area above the first floor shall be determined by the number of persons occupying such floor area, computed on the basis of fourteen persons for each 22 inches width of stairway, plus one person for every 3 square feet of hallway floor and stairway landings in the story height of such floor, excepting that in any building where a system of automatic sprinklers is installed throughout the entire building, as required in Section 195, the number and width of stairways may be computed on the basis of twenty-one persons for each 22 inches width of stairway; and excepting that when horizontal exits are provided as required in paragraph 2 (c) of this section, the number and widths of required stairways for floor areas above the first floor may be diminished to a basis of fifty persons for each 22 inches width of horizontal exit,

provided that in no case there shall be less stairway or means of exit than required in paragraph 3, (a) and (b) of this section.

NOTE.—In all building codes the treatment of exits must necessarily be largely theoretical until more systematic study of the subject has been made, and the correctness of conclusions based thereon have been demonstrated under practical service conditions.

As a fundamental principle, exit requirements are a function of the occupancy of a building and not of the area. To promote safety to life, two means of egress should be required from every floor of every building subject to exit specifications, irrespective of its area. Beyond this, exit calculations should be based solely upon the number of occupants.

The method herein employed for computing exit requirements is not claimed to be all that could be desired. It is an attempt to provide safety without too drastic demands, and is based upon the best information available. Experience may prove that changes should be made.

5. Exits shall also be provided from the cellar, basement, and first story of every building as may be required by the Superintendent.

6. The number of exits and stairways in tenement houses shall be as required in the Tenement House Law, Sections 287 and 295.

NOTE.—In buildings where large numbers of people are employed it is urged that fire drills be organized and practiced frequently enough to keep the employees familiar with their operation. The employees should also be taught that when once they have entered an enclosed stairway, or passed through a horizontal exit, they are safe, and can then proceed leisurely to the street with no necessity for undue haste or crowding. Conspicuous notices explaining these facts should be posted in all exit stairways.

Section 47. Fire Exit Partitions.

1. Partitions, erected to furnish horizontal exits, shall be built of fireproof materials. No construction shall be used for such partitions less than 5 inches thick, unless it has been approved after a fire test as prescribed in Section 174, paragraph 4; in no case shall such partition be less than 4 inches thick if of block or tile construction, or less than 3 inches thick if of reinforced concrete or solid metal lath and cement plaster construction, except as herein permitted for non-fireproof buildings.

When tile or block partitions are less than 5 inches thick, substantial protected reinforcement shall be provided

at intervals not exceeding 20 feet in length to resist the effect of buckling due to heat.

Requirements for horizontal exits, Sec. 46, par. 2, (c).

2. Fire exit partitions shall be supported at each floor, and shall be securely anchored to the walls, floor, and ceiling of the rooms which they subdivide. In fireproof buildings such partitions shall rest upon the fireproofing of the floor.

3. In non-fireproof buildings fire exit partitions shall be not less than 3 inches thick if of block or tile construction, and not less than $2\frac{1}{2}$ inches thick if of reinforced concrete or solid metal lath and cement plaster construction, and shall be continuous through all stories of the buildings and be placed one above the other. The space between floor joists included between the top of a partition in one story, and the bottom of the corresponding partition in the story above, shall be completely fire-stopped with incombustible material.

Fire-stopping of partitions, Sec. 97, par. 3.

NOTE.—In non-fireproof buildings it is recommended that fire exit partitions be of masonry construction not less than 8 inches thick, extending continuously from cellar to roof.

4. Doorways in fire exit partitions shall be not more than 60 feet apart, but doorways may be omitted if approved means of exit around the partitions are provided. No openings other than doorways protected by fire doors shall be placed in such partitions except that fire windows not exceeding $\frac{1}{2}$ of 1 per cent. of the area of the partition may be permitted where strictly necessary for purposes of observation. Such fire windows shall have fixed sash, and may be placed either in the partition itself or in the doors. Windows placed in partitions shall also be protected by automatic closing fire shutters. No single pane shall exceed 144 square inches in area, and not more than one pane shall be placed in a door.

NOTE.—The amount of glazed surface in such partitions should be kept as small as possible owing to the danger that in case of fire, the heat radiating through the glass would make the area of refuge untenable before the people who fled to it could escape by other exits. There would also be the added danger of panic if a large portion of the burning area were freely exposed to view.

5. Wired glass panels not exceeding 720 square inches in area are permitted in doors of fire exit partitions in corridors of hotels, clubs, dormitories and similar buildings.

NOTE.—To promote safety of life it is recommended that buildings of Class C, also office buildings and tenements, should not have above the first story, floor areas in excess of 2000 square feet without providing a horizontal exit. In buildings of that type this provision can be easily and inexpensively accomplished in a variety of ways.

Section 48. Exits and Protection for Existing Buildings.

1. Where the exit facilities of existing buildings are found by the Superintendent of Building Construction to be inadequate, additional exits, sprinklers, or other protection shall be provided of approved types.

NOTE.—The construction of fire exit partitions to provide horizontal exits in existing buildings, is probably the simplest, cheapest, and most efficient method of affording real safety to occupants in case of fire. They are particularly applicable to floor areas where many persons are employed or liable to congregate, also in the upper stories of buildings where outside succor would be difficult or impossible. See Note, Sec. 46, par. 2, (c).

2. In case the Superintendent may have declared an existing building unsafe, and ordered increased exit facilities, sprinklers or other protection, appeal may be made from such order to a Committee of Surveys, as provided in Section 325. The decision of that survey shall be final, and when it has been complied with, the Superintendent shall issue a certificate of occupancy to accord with such decision.

Certificate of occupancy, Sec. 8.

Section 49. Engineers' Stationary Ladders. Every building in which high-pressure steam boilers are placed in the cellar or lowest story shall have stationary iron ladders or stairs from such story leading direct to a manhole through the sidewalk or other outside exit in addition to another approved means of entrance and exit.

PART X.

TESTS, QUALITY, AND WEIGHT OF MATERIALS.

Section 50. Strength Test Requirements.

1. All building materials shall be of a quality to meet the requirements of this Code, and the test specifications promulgated by the Superintendent in accordance with the requirements of Section 316, paragraphs 4 and 6.

2. All tests shall be conducted under the supervision or direction of the Superintendent. Laboratory tests shall be made at some Testing Laboratory of recognized standing by a reputable, competent, and disinterested expert acceptable to the Superintendent. The tests shall be at the expense of the owner or builder. The test certificate shall state the source of the test specimen, the method of test, and the results obtained. Original signed copies of the certificates shall be furnished the Superintendent and shall be kept on file in his office subject to public inspection.

3. The Superintendent may at his discretion accept certified reports of tests made by responsible persons, provided such reports show that the material, appliance or method of construction have met the test requirements of this Code.

4. Materials, appliances or methods of construction which have been tested and approved shall be used and installed in the same manner in which they were tested for approval.

5. Additional tests shall be made from time to time at the discretion of the Superintendent.

*Strength tests for floor construction, Secs. 175-177.
Specifications for fire tests, Sec. 174.*

Section 51. Brick.

1. All bricks used in buildings, except those used for fire-stopping, Section 97 and 190, paragraph 5, shall be sound, hard-burned, or other approved brick of regular shape. Second-hand brick shall be thoroughly cleaned before being used. Not more than 15 per cent. shall be bats or broken brick.

2. Brick tested for approval shall develop an average strength of 3000 lbs. per square inch, and no sample shall fall below 2000 lbs. per square inch. Brick shall be tested flatwise (half bricks permitted), and the average shall be taken on at least five samples. The average allowable absorption shall not exceed 15 per cent.

NOTE.—Before brick or other masonry materials are submitted to absorption test, they should be dried to constant weight at a temperature between 225 and 250 degrees F., and should not be fully immersed when placed in the water. This aids the escape of air.

Section 52. Sand. Sand used for building construction shall be sharp, clean, coarse, and silicious.

Sand for reinforced concrete. Sec. 122.

Section 53. Lime.

1. Slaked lime (lime putty) shall be made from well-burned quick lime, free from ashes, clinker, and other foreign material.

2. Dry hydrated lime shall be the finely divided product resulting from mechanically slaking pure quick lime at the place of manufacture.

3. Lime shall be of quality to meet the specifications of the American Society for Testing Materials.

Section 54. Lime Mortar and Plaster. Lime mortar or plaster shall be made of one part by volume of slaked lime (lime putty), or dry hydrated lime, and not more than four parts by volume of sand.

Section 55. Cements. Portland cement and Natural cement shall meet the respective requirements of the current Standard Test Specifications of the American Society for Testing Materials for those cements, and any other requirements of the Superintendent. No caked or lumpy cement shall be used.

Section 56. Cement Mortar.

1. Cement mortar shall be made of cement and sand in the proportions of one part of cement and not more than three parts of sand by volume.

2. Hydrated lime may be added to portland cement mortar in amount not exceeding 15 per cent. of the cement by volume. The lime and cement shall be thoroughly mixed before the addition of water. The mortar shall be used immediately after water is added.

NOTE.—Cement mortar is improved by the addition of a small proportion of hydrated lime. It makes it work more smoothly under a trowel, and increases its waterproofness. Its strength is not decreased within the percentage of lime herein permitted.

3. Cement-lime mortar shall be made of one part of cement, one part of slaked lime or dry hydrated lime,

and not more than three parts of sand to each. All materials to be measured.

Section 57. Gypsum Mortar or Plaster.

A mortar or plaster composed of 1 part retarded gypsum, and not more than 3 parts sand, with binding material when necessary. For gypsum blocks, see Section 7, paragraph 34.

Section 58. Building Blocks.

1. The term "block" as used in this section shall mean any shape of block, brick or tile which forms a hollow or cellular wall.

2. Hollow clay blocks for bearing walls shall be dense, and hard-burned or vitreous.

Portland cement only shall be used in the manufacture of concrete blocks, and the coarse aggregate shall be of suitable material graded in size, but in no case shall the maximum dimension exceed one-half the thickness of the thinnest shell or web of the finished block.

3. All building blocks used for bearing walls shall be marked or branded for identification and such marks or brands shall be registered with the Superintendent. No make of blocks shall be used in any structure until the requisite number of samples have successfully met the test requirements of this section, and have been approved by the Superintendent.

Tests shall be made to establish the working stresses to govern the use of blocks of each particular mark or brand. A series of ten full size blocks shall be selected by the Superintendent from average quality stock, either at the factory, or from stock delivered for use at a building, and shall be tested for compression.

4. Concrete blocks shall be not more than 36 days old when tested.

5. The compressive strength of building blocks shall in all cases be calculated upon the gross sectional area of the bedding faces including the cellular spaces.

All blocks submitted to test shall be bedded in plaster of paris or cement to secure an even bearing.

Two piece blocks shall be tested in pairs as set to form the two faces of the wall. The strength requirement shall be the same as for hollow blocks, and it shall be calculated upon the gross sectional wall area which would be formed by the two blocks and the space between them.

6. The average ultimate compressive strength for hollow tile blocks designed to be normally laid with the cells vertical, and which are tested with the cells in that position, shall be not less than 1200 lbs. per square inch. The allowable working stress on such blocks shall not exceed 120 lbs per square inch.

7. The average compressive strength of hollow tile blocks which are designed to be normally laid with the cells vertical, but are tested with the cells horizontal, shall be not less than 300 lbs. per square inch, and no block of the set shall test less than 200 lbs. per square inch. The allowable working stress on such blocks when laid with the cells horizontal, shall not exceed 30 lbs. per square inch.

Requirements for hollow block walls laid with cells horizontal, Sec. 31, par. 3.

8. The average ultimate compressive strength for hollow tile blocks designed to be normally laid with the cells horizontal, and which are tested with the cells in that position, shall be not less than 800 lbs. per square inch. The allowable working stress on such blocks shall not exceed 80 lbs. per square inch.

9. The average compressive strength for concrete blocks when tested with the cells vertical, shall be not less than 700 lbs. per square inch; and 300 lbs. per square inch with no block testing at less than 200 pounds per square inch if tested with the cells horizontal. The allowable working stress for such blocks shall not exceed 70 lbs. and 30 lbs. per square inch respectively.

10. Hollow building blocks may be filled solidly with cement concrete or cement mortar to increase the stability and to aid in distributing the load, but the allowable working stress on such blocks shall not be greater than that permitted for unfilled blocks.

NOTE.—Tests have demonstrated that the strength of hollow tile blocks is not increased by being filled with concrete, the reason being the difference in strength and elasticity of the two

materials. Similar tests thus far available upon concrete blocks indicate some gain in strength by filling, but not sufficient to warrant recognition.

11. The absorption of building blocks used for bearing or panel walls, determined by taking the average test of three blocks, shall not exceed 10 per cent. in 48 hours, and shall not exceed 15 per cent. in any case.

12. Hollow building blocks shall not be used in fire-proof buildings until samples have successfully withstood a two-hour fire test as specified for partitions in Section 174, paragraph 4.

Walls of hollow building blocks, Sec. 31.

Hollow walls veneered, Sec. 21, par. 8.

Note on shells and webs, Appendix, page 297.

Section 59. Hollow Building Tile for Floors. Clay floor tile, when tested on end and faced with Portland cement, shall give an average compressive strength of not less than 2500 lbs. per square inch of net area. The average strength shall be computed from the results of test of ten average tile.

Working stress for clay floor tile, Sec. 111, par. 5.

Section 60. Concrete.

1. All mass concrete shall consist of a medium wet or plastic mixture of cement, sand, and stone, gravel, or other hard durable material, of such proportions as shall be approved by the Superintendent, unless specified by this Code. The sand and cement shall be of quality specified in Sections 52 and 55, and the coarse aggregate, where not specified by this Code, shall be as approved by the Superintendent.

Concrete for footings, Sec. 18.

Quality of reinforced concrete, Secs. 120-123.

2. All concrete shall be mixed, deposited and protected as required for reinforced concrete in Sections 154-156.

3. All forms and centering shall be built plumb and to true lines in a substantial manner, with joints sufficiently tight to prevent the leakage of the cement mortar. They shall be properly supported and braced to safely sustain both the dead load and the live load that may be placed upon them during construction.

4. All tests on concrete shall be made in accordance with the requirements of Sections 50 and 120, but the test strength of concrete other than that used with reinforcement shall be as specified by the Superintendent.

Test requirements for reinforced concrete, Secs. 120 and 167.

NOTE.—To increase the density of concrete, and thereby improve its waterproofness, some engineers advocate the addition of a small amount of hydrated lime. This practice is not objectionable provided the amount of lime added does not exceed 10 per cent of the volume of the cement. However, attention is directed to the fact that leakage of water through concrete due to contraction or other cracks, is independent of its density.

Section 61. Structural Timber. All timbers and wooden beams used in building shall be of good sound material, free from rot, large and loose knots, shakes, or any imperfection whereby the strength may be seriously impaired.

NOTE.—Attention is directed to a "Standard Classification of Timber Defects," and a "Standard Specification for Yellow Pine Bridge and Trestle Timbers" adopted by the American Society for Testing Materials and published in its Year Book.

Timber construction, Sec. 76.

Working stresses on timber, Sec. 65, par. 4, and Sec. 66, par. 4, also Appendix, pages 284 to 292.

Grading of yellow pine, Appendix, pages 278 to 283.

Section 62. Structural Steel and Iron.

1. All wrought and cast structural steel and iron shall conform to the test requirements of the current Standard Specifications of the American Society for Testing Materials.

2. *Rivet steel* shall have an ultimate strength of 46,000 to 56,000 lbs. per square inch.

3. All other structural steel shall show an ultimate strength of 55,000 to 65,000 lbs. per square inch.

4. No second-hand rolled shapes shall be used in any structure without the written permission of the Superintendent.

Quality of concrete reinforcement bars, Sec. 124.

5. *Steel Castings* shall be made from open hearth steel of soft or medium grade, and shall be practically free from

blow-holes, with a reasonably clear skin and sharpness to pattern, and shall show an ultimate tensile strength of 60,000 to 70,000 lbs. per square inch.

6. *Cast Iron* shall be of good foundry mixture, producing a clean, tough, gray iron. Castings shall be free from serious blow-holes, cinder spots, and cold shuts. Transverse tests on cast iron shall be made upon the 1¼-inch diameter "Arbitration Bar" of the American Society for Testing Materials. The bar to be supported on 12-inch centers, loaded at the middle, and in no case shall it test at less than 2900 lbs. Tensile tests optional.

Section 63. Weights of Materials.

The weights of various materials shall be assumed to be as follows:

	Pounds per Cubic Foot
Brickwork—Ordinary	120
Brickwork—Pressed brick	130
Concrete—Cinder, used for floor arches or slabs, well tamped	108
Concrete—Cinder, used for filling, not tamped	60
Concrete—Stone, or gravel.....	144
Granite, Bluestone, and Marble.....	170
Limestone	160
Sandstone.	145
Oak	50
Spruce and Hemlock.....	30
White Pine	27
Yellow Pine, Grade I (see Sec. 65, Note 2) ..	42
Yellow Pine, Grade II.....	35
Maple	43
Birch	45
Douglas Fir and Cypress	35

PART XI.

WORKING STRESSES.

Section 64. Computations for Working Stress.

1. The required dimensions of each piece of material and of each form of construction to be used in buildings shall be computed, according to the rules prescribed by

this Code, supplemented by those which may be promulgated by the Superintendent.

2. *Factors of Safety.*—Where the Code furnishes neither a unit working stress, nor a factor of safety for a material, the relation of allowable working stress to ultimate strength shall be determined by the Superintendent.

Section 65. Permissible Working Stresses.

1. The safe carrying capacity of the various materials of construction, when not otherwise specified, shall be determined by the following working stresses in pounds per square inch of sectional area:

2. *Steel and Iron.*

COMPRESSION IN SHORT BLOCKS.

	Pounds per Square Inch
Rolled steel	16,000
Cast steel	16,000
Cast iron	16,000
Steel pins, shop and power driven field rivets (bearing)	20,000
Steel field rivets (driven by hand) (bearing)	16,000
Steel field bolts (bearing)	12,000

TENSION.

Rolled steel	16,000
Cast steel	16,000
<i>Working stress on bolts in tension, Sec. 74, par. 6.</i>	
<i>Working stress on concrete reinforcement bars, Sec. 125.</i>	

SHEAR.

Steel web plates	10,000
Steel shop and power driven field rivets and pins	10,000
Steel field rivets (driven by hand)	8,000
Steel field bolts	7,000
Cast steel	9,000
Cast iron	1,500

EXTREME FIBRE STRESS.

Rolled steel beams, and riveted steel beams	16,000
Rolled steel pins, rivets and bolts	20,000
Cast iron compression side	16,000
Cast iron tension side	2,500

3. *Concrete and Masonry.*

COMPRESSION.

	Pounds per Square Inch
Grout, Portland cement, neat.....	1,000
Grout, Portland cement, neat between steel in foundation not over $\frac{1}{2}$ inch.....	1,500
Concrete, Portland cement, 1; sand, 2; stone, 4...	500
Concrete, Portland cement, 1; sand, $2\frac{1}{2}$; stone, 5.	400
Concrete, Natural cement, 1; sand, 2; stone, 4....	125
Concrete, Natural cement, 1; sand, $2\frac{1}{2}$; stone, 5..	80
Brickwork in Portland cement mortar.....	250
Brickwork in Natural cement mortar.....	208
Brickwork in lime and Portland cement mortar...	208
Brickwork in lime mortar.....	111
Hollow building tile, See Section 58.	
Hollow concrete blocks, See Section 58.	
Rubble stonework in Portland cement mortar....	140
Rubble stonework in lime and cement mortar....	100
Rubble stonework in lime mortar.....	70
Cut stone masonry, other than sandstone.....	600
Sandstone masonry	300
Granites, according to test.....	1,000 to 2,400
Gneiss	1,000
Limestones, according to test.....	700 to 2,300
Marbles, according to test.....	600 to 1,200
Sandstones, according to test.....	400 to 1,600
Slate	1,000

SHEAR.

Shearing stress involving diagonal tension in Portland cement concrete, in the proportions of 1-2-4	40
Direct shear (punching shear), in Portland cement concrete, in the proportions of 1-2-4.....	120
<i>Working stresses on reinforced concrete, Secs. 125, 167 and 168.</i>	

4. *Structural Timber.*

The following stresses apply to seasoned timber to be kept under shelter in a dry location, and deflection not to increase with time. If the timber is to be used under other conditions, these stresses should be modified.

	BENDING		COMPRESSION	
	Extreme Fibre Stress	Maximum Longitudinal Shear	Perpendicular to the Grain	Parallel to the Grain, Columns with $\frac{l}{d}$ less than 10
Oak	1,400	120	400	1,000
Yellow Pine, Grade I.	1,600	125	350	1,200
Yellow Pine, Grade II	1,300	85	300	900
Douglas Fir	1,500	100	325	1,100
Eastern Spruce	1,000	75	200	900
Western Hemlock ...	1,300	75	250	1,000
Norway Pine	1,000	75	250	800

l =unsupported length in inches.

d =diameter or least side in inches.

Where a moderate increase in deflection after first placement of the load is not objectionable, the compression and extreme fibre stresses here given may be increased 10 per cent. Stresses for timbers subject to vibration and impact, should not be thus increased.

Except for shear, the same stresses may be used for Douglas Fir of Grades I and II as for Yellow Pine of Grades I and II, provided the fir is selected in a manner to insure material of corresponding quality. See Explanatory Note 3, page 282.

NOTE 1.—The stresses given in this table were compiled from data obtained from the U. S. Forest Service and other reliable sources, and are based upon tests of timber in commercial sizes selected under expert inspection. The yellow pine was selected under the Grading Rules given in the Appendix. In some respects test data is still incomplete, and future investigations may justify changes in the values given. The data available upon strength of redwood seems insufficient to warrant including it in the table.

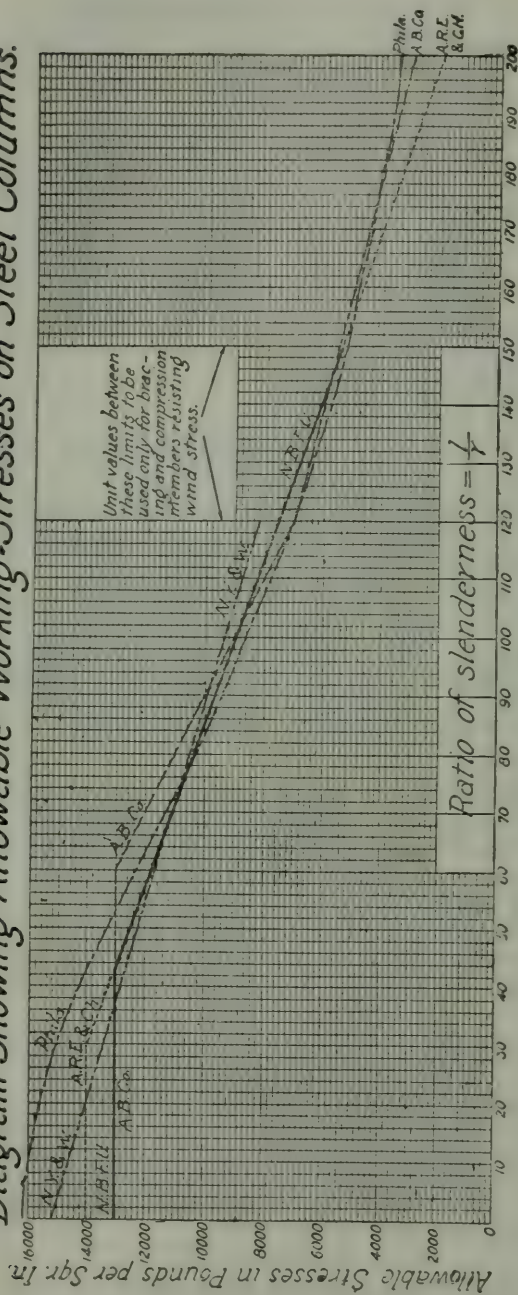
Tables I to VI on pages 286 to 292 in the Appendix, were calculated from the stress values given in this table, and will be found useful for floor construction computations, and in the determination of permissible floor loads.

NOTE 2.—Explanation for the abandonment of the terms "longleaf" and "shortleaf" yellow pine, and the adoption of the terms "Grade I," and "Grade II," applied to that variety of timber, will be found in the Appendix, page 278.

Section 66. Working Stresses for Columns.

1. The working stresses per square inch for all steel, cast iron, or wooden columns having flat ends shall not exceed the values given by the following formulas:

Diagram Showing Allowable Working-Stresses on Steel Columns.



Compression Formulas

— National Board of Fire Underwriters (N.B.F.U.) $S = 16000 - 70 \frac{l}{r}$; max. $S = 13000$; max. $\frac{l}{r} = 150$

..... American Railway Engineering Assn. & Chicago (A.R.E. & Ch.) $S = 16000 - 70 \frac{l}{r}$; max. $S = 14000$; max. $\frac{l}{r} = 150$

— Building Codes of New York & Washington (N.Y. & W.) $S = 15200 - 56 \frac{l}{r}$; max. $\frac{l}{r} = 120$

— Ameritan Bridge Company (A.B. Co.) $\left\{ \begin{array}{l} S = 19000 - 100 \frac{l}{r} ; \text{ max. } S = 13000 ; \text{ max. } \frac{l}{r} = 120 \\ S = 13000 - 50 \frac{l}{r} \text{ for values of } \frac{l}{r} \text{ between } 120 \text{ and } 200 \end{array} \right.$

— Philadelphia (Phila.) $S = \frac{16250}{1 + \frac{l^2}{11000r^2}}$

$S =$ allowable stress.

$l =$ length in inches

$r =$ radius of gyration

Fig. 16.

2. *Steel Columns.*

Working stress, $S = 16,000 - 70 \frac{l}{r}$

Where S = allowable compression in lbs. per square inch.

l = allowable length in inches.

r = least radius of gyration in inches.

The allowable compression (S) shall not exceed 13,000 lbs. per square inch, and the ratio of slenderness $\frac{l}{r}$ shall not exceed 120, except that for bracing and for compression members resisting wind stress only, $\frac{l}{r}$ shall not exceed 150.

NOTE.—The above formula, together with the column formulas specified by the American Railway Engineering Association, The American Bridge Co., and in the Building Codes of the cities of New York, Chicago, Philadelphia and Washington, are shown graphically in Figure 16. The diagrams give the allowable working stresses which each formula would permit, and by comparison it will be seen that the formula here recommended represents average general practice.

Construction of steel columns, Sec. 70.

Working stresses for reinforced concrete columns.

Secs. 141-145.

Column loads, Sec. 41.

3. *Cast Iron Columns.*

Working stress, $S = 9000 - 40 \frac{l}{r}$

Maximum $\frac{l}{r}$ shall not exceed 60.

Construction of cast iron columns, Sec. 68.

4. *Wooden Columns.*

	For Columns with $\frac{l}{d}$ greater than 10, but not exceeding 30.
Oak	1,200-20 $\frac{l}{d}$
Yellow Pine, Grade I.....	1,400-20 $\frac{l}{d}$
Yellow Pine, Grade II.....	1,100-20 $\frac{l}{d}$
Douglas Fir	1,300-20 $\frac{l}{d}$
Spruce	1,100-20 $\frac{l}{d}$
Western Hemlock	1,200-20 $\frac{l}{d}$
Norway Pine	1,000-20 $\frac{l}{d}$

l = unsupported length in inches.

d = diameter or least side in inches.

The unsupported length of wooden columns and compression members shall not exceed 30 times the diameter or least side, nor shall the unit stresses exceed those given in the table in Section 65 for $\frac{l}{d}$ less than 10.

Wooden columns with $\frac{d}{l}$ less than 10, Sec. 65, par. 4.

Ordinary timber construction, Secs. 76-79.

Mill construction, Secs. 102-109.

Quality of structural timber, Sec. 61.

5. Columns Eccentrically Loaded. The stresses of every column which is eccentrically loaded shall be computed. The sum of the stresses due to the eccentricity added to all other stresses shall in no case exceed the working stresses stated in this code.

The eccentric load of a column shall be considered to be distributed equally over the entire area of the column at the next point below that at which the column is securely braced laterally in the direction of the eccentricity.

Section 67. Wind Pressure.

1. All buildings or parts of buildings in which the height is more than three times the minimum horizontal dimension shall be designed to resist a horizontal wind pressure in any direction of 20 lbs. for every square foot of exposed surface. Wind bracing shall be provided by making the connection joint between girders and columns sufficient for the vertical load as well as the bending due to side pressure; or diagonal bracing shall be placed between columns, proportioned to transfer the shear of the side pressure to the footings. All details shall be designed to carry the stresses in the main members.

2. The overturning moment due to wind pressure shall not exceed 50 per cent. of the moment of stability of the structure, unless the structure is securely anchored to the foundation. The anchors shall be of sufficient strength to safely carry the excess overturning moment, without exceeding the allowable unit stresses given in this Code.

3. When the stress due to the wind in any member or connection amounts to less than 50 per cent. of the total live and dead loads, it may be neglected. When the stress due to the wind exceeds 50 per cent. of the stress due to

the combined live and dead loads, all these stresses shall be added together and the allowable unit stress for the total may be taken at 50 per cent. in excess of the values stated in Sections 65 and 66. In no case shall the section be less than required if wind forces be neglected.

4. In the design of circular chimneys, the area subject to wind pressure may be assumed as 60 per cent. of the diametral area.

Wind pressure on signs, Sec. 263, par. 6.

PART XII.

CAST IRON CONSTRUCTION.

Section 68. Cast Iron Columns.

1. The outside diameter or least side of cast iron columns shall be not less than 5 inches, nor shall their unsupported length exceed sixty times their least radius of gyration.

2. The finished thickness of metal in the shaft shall not be less than one-twelfth the outside diameter or the greatest lateral dimension of cross section, nor less than $\frac{3}{4}$ inch. The thickness of metal in flanges, lugs, seats, and brackets shall be not less than 1 inch.

3. In all cast-iron columns not cast with one open side, at least three holes $\frac{3}{8}$ inch diameter shall be drilled 90 degrees apart near the middle of the shaft for the purpose of measuring the thickness of metal.

4. Whenever the core of a cast iron column has shifted more than one-fourth the thickness of the shell, the strength shall be computed assuming the thickness of metal all around equal to the thinnest part, and the column shall be rejected if this computation shows the strength to be less than required by Section 62, paragraph 6.

5. A cast iron column shall be rejected whenever blow-holes or other imperfections reduce the effective area of the cross-section more than 10 per cent.

6. The ends of all cast iron columns shall be planed to a true surface perpendicular to the axis of the column. Successive column lengths shall be bolted together through end flanges with at least four bolts not less than $\frac{3}{4}$ inch in diameter. No shims shall be used between the flanges.

7. If the core of a cast-iron column below a joint is larger than the core of the column above, the core of the lower column shall be tapered up for a distance of not less than 6 inches, to the size of the core of the column above. In lieu of tapering the core, a steel or cast iron plate of sufficient thickness may be used between the flanges. The difference between the diameters or sides of any two successive column lengths shall not be greater than 2 inches.

8. The connection of beams and girders to cast iron columns shall be effected by means of seats reinforced by brackets of sufficient depth and thickness to support the entire load, and by lugs to which the webs of the beams and girders shall be bolted. The projection of the seat beyond the face of the column shall in general be not greater than 4 inches.

9. All holes in cast iron columns shall be drilled. Cored, or cored and reamed holes shall not be permitted. The diameter of holes shall not exceed that of the bolts by more than $\frac{1}{16}$ inch. The distance from the center of a hole to the edge of a flange or lug shall be not less than $1\frac{1}{2}$ inches.

10. Cast iron columns shall not be used in any case where the load is sufficiently eccentric to reduce the unit compression to zero in the extreme fibre on one side of the axis of the column.

11. Cast iron columns shall not be used in the structural frame of buildings, the height of which is greater than three times their width.

12. Cast iron columns shall not be painted or covered until after inspection by the Superintendent of Buildings.

Quality of cast iron, Sec. 62, par. 6.

Section 69. Cast Iron Bases and Lintels.

1. Cast iron bases or shoes shall be planed on top. Bases which rest on steel girders shall be planed top and bottom. The thickness of metal shall be not less than 1 inch. The inclination of the outer edge of the ribs with the horizontal shall be not less than 45 degrees. Whenever one side of the bed plate exceeds 3 feet in length a reinforcing flange at least 3 inches high shall be provided.

2. Cast iron lintels shall be not less than $\frac{3}{4}$ inch in thickness, and shall not be used for spans exceeding 6 feet.

PART XIII.

STEEL CONSTRUCTION.

Section 70. Rolled Steel Columns.

1. No rolled steel column shall contain material whether in the body of the column or used as lattice-bar or stay-plate of less thickness than $\frac{1}{4}$ inch.

2. In steel columns built up of a web plate and angles and having an unsupported length greater than sixty times the least radius of gyration, the thickness of metal in the angles shall be not less than one-twelfth the width of the outstanding legs of the angles.

3. The unsupported length of a rolled steel column shall not exceed one hundred and twenty times its least radius of gyration, nor forty times its least lateral dimension or diameter.

4. The ends of all columns shall be faced to a plane surface at right angles to the axis of the columns. Wherever practicable, the connections between them shall be made with splice plates. When the sections of the columns to be spliced are such that splice plates cannot be used, a connection formed of plates and angles designed to properly distribute the stress may be used.

5. Where any part of the section of a column projects beyond that of the column above, the difference shall be made up by filling plates secured to the column by the proper number of rivets.

6. The pitch of rivets at the ends of built up columns shall not exceed four diameters of the rivet for a length equal to twice the greatest lateral dimension of the column.

Quality of structural steel, Sec. 62.

Section 71. Steel Girders and Beams.

1. The thickness of the web in built up girders shall be not less than one-one hundred and twentieth of the distance between the flange angles or stiffeners, nor less than $\frac{1}{4}$ inch.

2. When the unsupported length (l) of the compression flange of a girder exceeds ten times its width (b) the unit stress in such flange shall not exceed $19,000 - 300 \frac{l}{b}$ but in no case shall the unsupported length of the compression flange exceed forty times its width.

3. Stiffeners shall be provided over supports and under concentrated loads; they shall be of sufficient strength as a column to carry the loads and shall be connected with a sufficient number of rivets to transmit the stress to the web plate.

If the unsupported depth of the web plate exceeds sixty times its thickness, intermediate stiffeners shall be provided. All stiffeners shall be in pairs with close bearing against the flange angles.

4. When rolled steel beams are used in pairs to form girders they shall be connected together by bolts and iron or steel separators at intervals of not more than 5 feet.

All beams 12 inches and over in depth shall have at least two bolts to each separator.

5. Beams supported by girders shall be riveted or securely bolted to the same.

6. Every beam, lintel, or girder supported by a wall, shall be properly anchored thereto and shall rest upon a steel or iron plate so designed as to properly distribute the load over the masonry.

Section 72. Framing and Connecting Structural Steel Work.

1. Steel girders, columns, beams, trusses, and other steel work of floors and roofs shall be well and firmly connected together, and to the walls.

2. All beams framed into other beams, girders or columns shall be connected thereto either by angles or knees with sufficient rivets or bolts in both legs of each connecting angle to transmit the entire load coming on the connection to the supporting beam, girder or column; or a seat sufficiently strong to carry the full load with a side angle to hold the beam in place may be used.

Section 73. Steel Trusses.

1. Trusses shall be so designed that the stresses in each member can be calculated.

2. All trusses shall be held rigidly in position by efficient systems of lateral and sway bracing, struts being spaced so that the maximum limit of length to least radius of gyration, established in this Code, is not exceeded.

3. For tension members the actual net area only, after deducting rivet holes $\frac{1}{8}$ inch larger than the rivets, shall be considered as resisting the stress.

4. Compression members in pin-connected trusses shall be so designed that the stresses shall not exceed 75 per cent. of the permissible working stress for columns. The heads of all eye-bars shall be made by upsetting or forging. No weld shall be allowed in the body of the bar. Steel eye-bars shall be annealed. Bars shall be straight before boring.

5. All pin-holes shall be bored true and at right angles to the axis of the members, and must fit the pin within $\frac{1}{32}$ inch. Eye and screw ends shall be so proportioned that upon test to destruction fracture will take place in the body of the member. All pins shall be accurately turned.

Section 74. Riveting and Bolting.

1. All component parts of built up columns, girders, and trusses shall be riveted. All column connections in buildings over four stories in height shall be riveted. Riveting shall also be used in column splices, in web and flange splices of girders and trusses, and in all connections of beams and girders to columns.

Quality of rivet steel, Sec. 62, par. 2.

2. Where riveting is impracticable, turned bolts may be used provided the holes for same are punched and reamed to a template and the bolts are accurately fitted.

3. All shop rivets, wherever practicable, shall be machine driven. The pitch of rivets shall never be less than three diameters of the rivet, nor more than 6 inches. In the direction of the stress it shall not exceed sixteen times the least thickness of the outside member. At right angles to the stress it shall not exceed thirty-two times the least thickness of the outside member.

4. Rivets shall fill the holes completely; the heads shall be hemispherical and concentric with the axis of the rivet; the length between heads, shall not exceed five times the diameter.

5. Where riveting is not required, connections may be made by bolts which shall be of wrought iron or mild

steel with United States standard threads. The threads shall be full and clean; the nut shall be truly concentric with the bolt; and the thread shall be of sufficient length to allow the nut to be screwed up tightly.

6. When bolts are used in tension, the working stresses shall be reduced to 7000 pounds per square inch of net area for steel, and to 5000 pounds per square inch for wrought iron, and the load shall be transmitted into the head or nut by washers distributing the pressure evenly over the entire surface of the same.

7. In the construction of exterior stairs, landings, platforms and balconies, no rivet shall be less than $\frac{3}{8}$ -inch diameter, and no bolt less than $\frac{1}{2}$ -inch diameter.

Quality of steel castings, Sec. 62.

Section 75. Protection of Structural Metal against Corrosion.

1. All metal structural work shall be cleaned of all scale, dirt and rust, and be given one coat of paint at the shop completely covering all exposed surfaces. After erection all such work shall be painted at least one additional coat of a shade different from the first coat. The first coat of paint shall be made of pigments which shall be chemically inert after application, and shall be mixed with linseed or other drying oil. The amount of volatile matter shall be sufficient for easy spreading, and shall not injure the film of the paint. The paint must dry sufficiently hard within 24 hours so that it will not rub off or abrade easily. When the steel reaches the job all abraded or injured portions must be thoroughly recoated with the same material as the shop coat before the second coat is applied. The second coat of paint shall be such as will not act as a solvent of the first coat, and shall be mixed with a pigment which shall be inert after application, and the vehicle shall be one that will not saponify under the action of cement mortar.

2. Surfaces of riveted work which come in contact with each other, shall be painted with two coats of paint before assembling.

3. All iron or steel used in damp locations or under water shall be embedded in Portland cement concrete. No paint shall be applied to the steel surfaces which are to be encased in concrete.

4. Any structural steel work which may be so placed as to be inaccessible for inspection after erection, shall be thoroughly cleaned of all rust and encased in Portland cement concrete before it is rendered inaccessible.

Protection of wall columns, Sec. 112, par. 1.

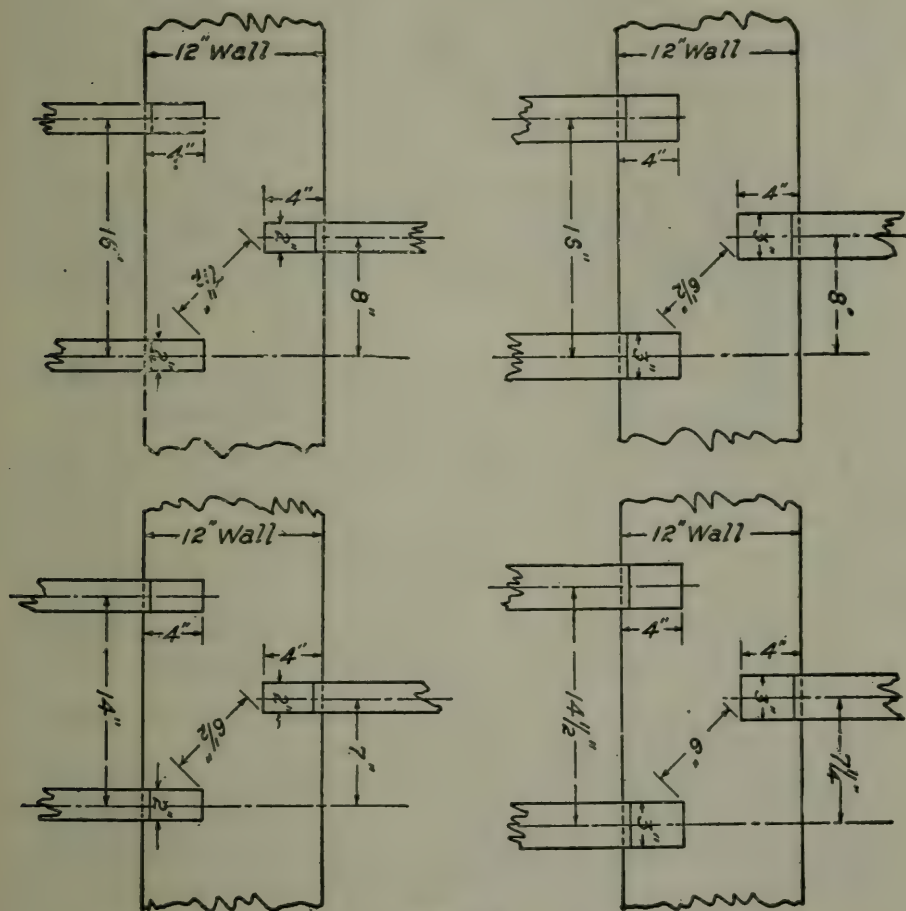


FIG. 17.

Diagram showing placing of floor beams in a wall to secure a separation of at least 6 inches between the ends.

PART XIV.

ORDINARY TIMBER CONSTRUCTION.

Section 76. Wooden Beams or Joists.

1. Every wooden beam in any party or fire wall shall be separated from any other beam in the wall by at least

6 inches of solid masonry. Such separation may be obtained by staggering the beams, corbeling, or by use of approved steel hangers properly anchored in the wall, and arranged to make the beams self-releasing. No wall shall be corbeled more than 2 inches for this purpose. If the beam ends are opposite each other in the wall the separation shall be not less than 8 inches. Fig. 17 indicates spacing and arrangement of beams of different thickness in a 12-inch wall which will meet the requirement of this section. The spacing could be reduced if the walls under the beams were corbeled.

NOTE.—Staggering the beams distinctly lessens the danger of transmission of fire through a wall, for the reason that the fire or highly heated air must travel through two joints at right angles to each other to pass from one beam to the other. The probability of both joints being open is much less than in the case of one straight connecting joint.

2. No wooden floor or roof beam used in any building within the fire limits shall be less than 3 inches thick.

3. The thickness of wooden beams shall be not less than 3 inches in any building where the floor load is greater than 60 pounds per square foot.

NOTE.—In paragraphs 2 and 3 actual mill sizes are acceptable.

4. Trimmer and header beams over 4 feet in length shall be hung in approved metal stirrups or hangers.

5. Every wooden beam, except header and tail beams, shall have bearings of at least 4 inches.

NOTE.—In designing wooden floor constructions to carry heavy loads, it is important to take into account the resistance of wood to crushing perpendicular to the grain. Frequently the area allowed for support of the ends of wooden beams is so small that crushing occurs while other proportions are ample for the load.

6. The ends of all wooden floor and roof beams, which rest on walls, shall be cut to a bevel of 3 inches in their depth.

7. Neither end of a floor or roof beam shall be supported on stud partitions, except in dwellings.

8. All wooden floor and roof beams shall be properly braced with cross bridging. The distance between bridging or between bridging and bearing shall not exceed 8 feet. So far as possible knots or other imperfections shall be ex-

cluded from the bottom and top quarters of timber beams. See Grading Rules (2) and (7) for Yellow Pine, Appendix, pages 279 and 286. Also Explanatory Note (6), page 283.

Quality of structural timber, Sec. 61.

Timber stresses, Sec. 65, par. 4.

Safe loads for wooden beams of varying size and Span, Appendix, pages 268 to 292.

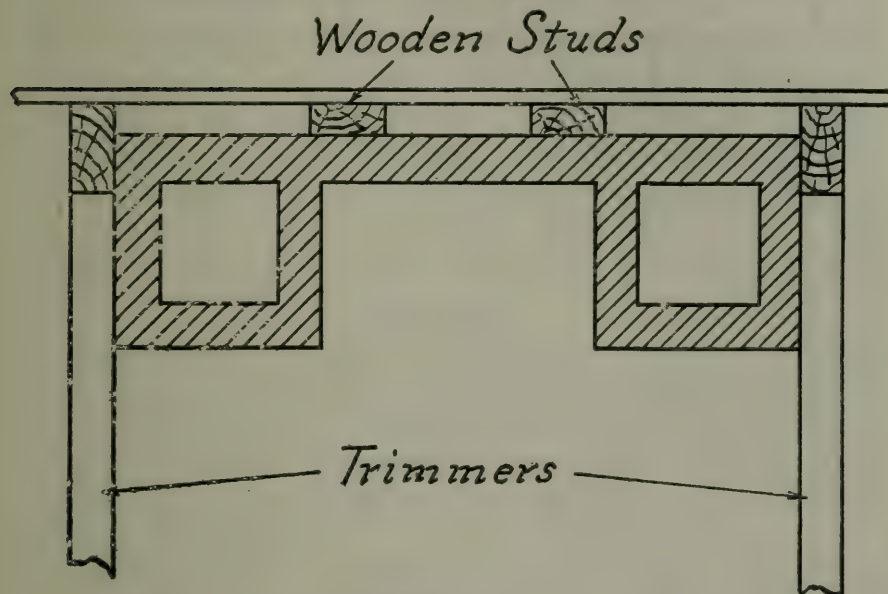


FIG. 18.

Diagram showing two common features of dangerous chimney construction. Woodwork placed against chimneys, and unlined flues.

Section 77. Wooden Beams Separated from Masonry Chimneys.

1. No wooden beams or joists shall be placed within 2 inches of the outside face of a chimney or flue, whether the same be for smoke, air or any other purpose.

2. No woodwork shall be within 4 inches of the back face of the wall of any fireplace. Figs. 18 and 19.

3. For smoke flues of boilers and furnaces where the brick work is required to be more than 8 inches in thickness, the header beams shall be not less than 4 inches from the outside of the brickwork.

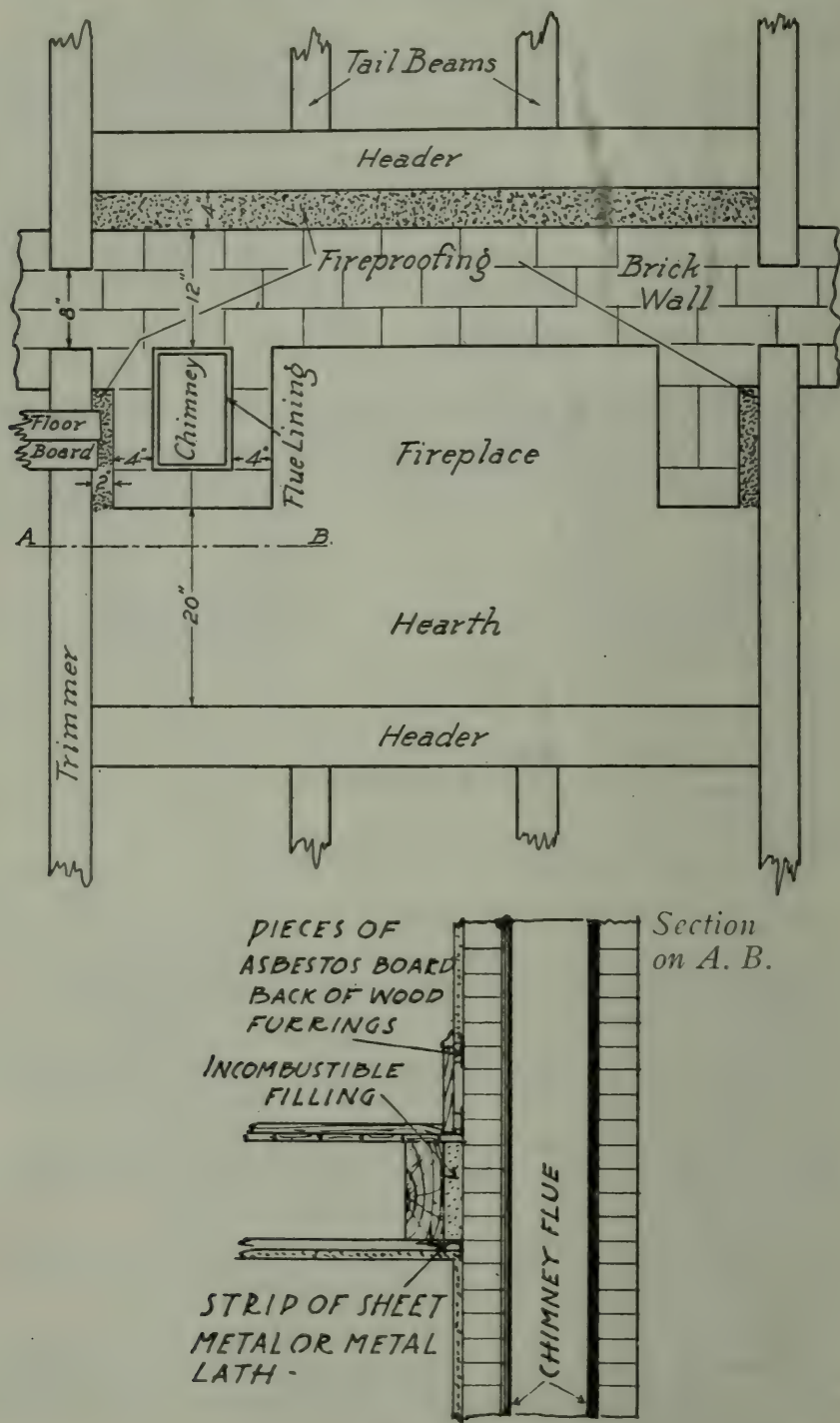


FIG. 19.
Fire-stopping around chimney and fireplace.

4. All spaces between the chimney and the wooden beams shall be filled with mineral wool, loose cinders, gypsum block, or other porous incombustible material. See Fig. 19.

NOTE.—The object of this filling of dead air spaces around a chimney before the flooring is laid, is to prevent an accumulation of shavings and other combustible material in them, also to prevent the danger of mice building nests there. The filling material should be porous to preserve the heat insulating advantage of the air cells, consequently brickwork, mortar, or solid concrete should not be used.

5. The header beam, carrying the tail beams of a floor, and supporting the trimmer arch in front of a fireplace, shall be not less than 20 inches from the chimney breast.

6. No wooden furring or studding shall be placed against any chimney; the plastering shall be directly on the masonry, or on metal lathing. Separate wooden trim from plaster on masonry of chimney, by $\frac{1}{8}$ inch asbestos board. See Fig. 19.

Section 78. Anchors for Wooden Beams and Girders.

1. Each tier of beams shall be anchored to the walls with steel anchors at intervals of not more than 6 feet.

2. Where the beams are supported by girders, the girders shall be anchored to the walls and fastened to each other by steel straps.

3. The ends of wood beams resting upon girders shall be abutted together, end to end, or lapped, spiked, and strapped by steel straps of the same size and distance apart, and in the same manner as the wall anchors.

4. Each tier of beams running parallel to enclosing walls shall have approved 4-inch anchor strips dovetailed into the beams diagonally, crossing at least four beams.

5. Every pier shall also be well anchored to at least three beams of each story, with steel anchors.

Fire-stopping of wooden construction, Sec. 97.

Section 79. Timber Columns, Posts, and Trusses.

1. All timber columns and posts shall be squared at the ends perpendicular to their axes, and iron or steel cap plates and base plates shall be provided.

2. Where the cap plate of a timber column or post supports a wooden girder any column above shall bear directly

on the metal cap and shall not rest on the girder. Steel cheek plates shall be bolted to the girders and post, when required for safety.

3. All bolts used in connection with timber work shall be provided with washers of such proportions as will reduce the compression on the wood at the face of the washer to that allowed in Section 65, paragraph 4, supposing the bolt to be stressed to its limit.

Timber prohibited in walls, Sec. 21.

Timber column stresses, Sec. 65, par. 4, and Sec. 66, par. 4.

NOTE.—It is important that timber used for interior construction be thoroughly seasoned, especially if it is to be encased in a manner to prevent a free circulation of air about it; otherwise there is danger of dry rot attacking the timber and in a few years causing great expense for replacement, and at the same time increasing the fire hazard. Many cases of serious deterioration of this kind have recently been brought to public attention, particularly in mills and factories where a humid atmosphere prevails. Under such circumstances it is imperative that much care be exercised in selection of the timber to insure that it is not only well seasoned, but that it contains the least amount of sap wood possible, and that the timber is not attacked by rot fungus before it is put in the building. Sap wood is very susceptible to dry rot, and should not be permitted in places where subject to dry rot conditions. In most cases the danger from this disease warrants the expense of antiseptic treatment of the timber. Attention is called to an excellent paper on this subject, "Specifications for Factory Timbers," Trans. Am. Soc. Mechanical Engineers, 1913.

PART XV.

ROOFS AND ROOF STRUCTURES.

Section 80. Roof Coverings.

1. All buildings except as given below shall have roof coverings of approved standard quality, such as brick, concrete, tile, or slate; or highest grade of tin roofing, or of asbestos shingles, or of built-up roofing felt with gravel or slag surface, or of built-up asbestos roofing; or other roofings of like grade which would rank as Class A or B under the test specifications of the Underwriters' Laboratories.

Exceptions:

- (a) Dwellings;
- (b) Frame buildings;
- (c) Buildings not exceeding two stories or 30 feet in height and 2500 square feet in area, and not used for factories, warehouses, or mercantile purposes.

2. The quality of roofing for all dwellings and other buildings exempted in paragraph 1, shall be as therein specified; or may be of a grade not lower than that indicated in the definition of approved fire-resisting roofing, Section 7, paragraph 3; or of a grade which would rank not lower than Class C, under the test specifications of the Underwriters' Laboratories.

3. A layer of roofing felt at least $\frac{1}{16}$ inch thick shall be placed between metal roofing and the supporting wood-work.

NOTE.—The purpose of the felt is to prevent quick ignition of the wooden decking when the roof is exposed to burning brands or radiated heat.

4. The wooden planking and sheathing of roofs shall not in any case be extended across side or party walls.

5. Any roof having a pitch over 60 degrees, placed on any building over 40 feet high, except towers or church spires as specified in Section 188, shall be constructed of iron or steel frames filled with fireproof material not less than $3\frac{1}{2}$ inches thick, and shall be covered with approved roofing.

6. All flashings shall be of metal properly incorporated with the roofing material. Copper flashings are recommended.

7. The top and sides of dormer windows shall be protected the same as the roof.

8. This section shall not be construed to prohibit the repairing of a wooden shingle roof, provided the building is not increased in height, but the renewal of such a roof is forbidden. No existing wooden shingle roof, if damaged more than 10 per cent., shall be repaired with other than approved roofing.

NOTE.—In addition to the above it is suggested that a clause be inserted in the building ordinance, stating that on or before a certain date, any or all roofs now covered with wooden shingles

shall have them replaced with approved roofing material corresponding with the requirements for new buildings. The date should be made as early as consistent with securing to the owners of the buildings a reasonable service for roofs which may have been constructed shortly prior to the adoption of the Building Code.

Test of approved roofing, Sec. 174, par. 8.

Roof loads, Sec. 40.

Fireproof roof construction, Sec. 111, par. 7.

Section 81. Roof Leaders. All buildings shall be provided with proper metal leaders, which shall be connected to the sewer. Where there are no sewers such leaders shall be connected by pipes below the surface to the street gutter or a cesspool. Detached dwellings, or other one-story buildings, may be exempt from the requirements of this section at the discretion of the Superintendent.

Section 82. Scuttles on Roofs. Upon the roof of every building more than 15 feet high, which is not required to have stairs and bulkhead leading thereto, there shall be a scuttle with stairs or substantial stationary step ladder leading to same, which shall be easily accessible at all times to all occupants without the use of keys. All non-fireproof scuttles shall be covered on the top and edges with sheet metal or other approved fireproof material. The roof opening shall be at least 2 feet by 3 feet in size.

Section 83. Pent Houses and Bulkheads.

1. All inclosures upon roofs for tanks, elevators or elevator machinery, and all pent houses and bulkheads upon non-fireproof buildings shall be of fireproof construction, or may be built of wooden studs filled with brick or other incombustible material and completely covered with metal or other approved incombustible material; and all windows, doors and trim shall be of metal, or metal covered, and be glazed with wired glass where glass is used.

2. All such structures upon fireproof buildings shall be of fireproof construction, including floors, and in all cases the outside surface shall be covered with approved incombustible weatherproof material, including all surfaces and the edges of doors and jambs.

3. Bulkheads or pent houses when used only for the purpose of enclosing staircases to roofs, elevator machinery,

water tanks, ventilating apparatus, exhaust chambers, or other machinery, need not be considered in determining the height of the building.

Pent houses when occupied for purposes other than hereinbefore described, shall not exceed 12 feet in height, and shall not occupy more than 75 per cent. of the area of the roof, including all other bulkheads or pent houses; excepting that in tenement houses the requirements of Sec. 277, paragraphs 2 and 3, shall apply, and excepting that no pent house shall be occupied or used for purposes other than for the exclusive use of the janitor.

4. No staging, stand, sign, or other structure shall be constructed upon the roof of any building without first obtaining the approval of the Superintendent.

Roof loads, Sec. 40.

Roofs on mill construction, Sec. 107.

Signs and billboards, Sec. 263.

Section 84. Tanks.

1. Tanks of more than 500 gallons capacity placed within any building, or on or above the roof of any building, shall be supported by steel or masonry of sufficient strength to carry the same safely. Beams shall rest at both ends on steel girders, iron or steel columns, or walls or piers of masonry.

The supporting I beams shall either have the ends built into masonry work, or shall be securely framed together in a manner to prevent possibility of overturning or buckling due to oscillation of the tank in a wind storm.

NOTE.—Some bad tank disasters have occurred due to neglect of this requirement.

2. In or near the bottom of each tank there shall be a pipe or outlet not less than 4 inches in diameter, fitted with a suitable gate valve, to permit ready drainage of the tank in case of necessity.

3. Wooden covers of tanks on roofs shall be covered with metal. Hoops of wooden tanks shall be of metal having circular cross-section.

Tanks for sprinkler system, Sec. 195, par. 8-9.

4. Tanks having a capacity exceeding 1000 gallons and placed on or within non-fireproof buildings, shall

have the supporting steel framework thoroughly encased in fireproofing material.

Section 85. Cornices and Gutters.

1. On all buildings or structures within the fire limits the exterior cornices, inclusive of those on show windows and gutters, shall be of incombustible material. All cornices not built as a part of the walls, shall be secured to the walls with metal framing or anchors.

2. Exterior wooden cornices or gutters on buildings or structures within the fire limits, which are unsafe or are damaged to the extent of one-half, shall be taken down; any replacement of same shall be made with incombustible materials. If damaged less than one-half, they may be repaired with the same material as originally constructed.

3. Outside of fire limits where buildings having masonry walls are placed nearer than 3 feet to a side or rear lot line, or 5 feet to another building, the cornices and overhanging eaves on the side or rear walls shall be of, or covered with, incombustible material. When such buildings are erected in rows, combustible cornices on the front shall be fire-stopped with incombustible material between each building.

NOTE.—The most vulnerable point of attack for an exposure fire of this kind is under the eaves, for the heat banks up there and the woodwork is always highly combustible since never exposed to storms. With ordinary construction numerous cracks are almost certain to exist alongside the rafters communicating directly with the attic space which is usually difficult of access, and liable to be filled with combustible material. It is therefore important that the space above the plate and between the rafters be filled as tight as possible. Where masonry walls are used they should extend up to the underside of the roof boards.

Projection of cornices, Sec. 101, par. 4.

Section 86. Skylights.

1. All skylights shall have metal frames and sash, and the frames and parts thereof shall be riveted or otherwise securely fastened in addition to soldering.

2. Except as herein provided, all skylights shall be glazed with wired glass, or heavy plain glass may be used, if protected above by galvanized wire screens. If plain glass be used in skylights on buildings of a public character

over any passageway or room of public resort, wire screens shall be placed beneath the skylights as well as above.

3. No wired glass shall be placed in a skylight at the top of enclosures for elevators, stairways, dumbwaiters, vent and light shafts, or over a theatre stage; all such skylights shall be glazed with thin glass and shall be protected by galvanized wire screens. The mesh of such screens shall not exceed 1 inch, and the wire shall be of a size not less than No. 12 gauge. All screens shall have substantial metal supports and shall be placed at least 6 inches above skylights and project 6 inches beyond edges of skylights.

4. When metal louvres are used for ventilating purposes, over shafts or in connection with skylights, the louvres or slats shall be riveted to the metal frame.

5. Instead of a skylight over a shaft, a window of equivalent area may be placed in the side of the shaft above the roof, which is furthest removed from a property line. The window shall have incombustible frame and sash, and be glazed with thin glass.

NOTE.—Automatic ventilators or skylights, which are controlled by fusible links located at different points in the shaft, are also recommended. Such devices, if arranged to open very surely upon fusing of a link, afford quick release of smoke and hot explosive gases.

6. Except windows in the side of shafts above the roof, wired glass only shall be used in skylights which are vertical or inclined at an angle of over 45 degrees, when subject to an exposure which would require wall openings to be protected by fire windows or fire doors.

Area of shaft skylights, Sec. 90, par. 7.

Theatre stage ventilators, Sec. 247.

NOTE.—For complete details of skylight construction, see "Regulations of the National Board of Fire Underwriters governing Roof Openings, Cornices and Gutters."

Section 87. Protection of Skylight and Roof.

1. Where walls are carried up above the roofs of adjoining buildings, proper means shall be provided and used by the person erecting the walls for the protection of the skylights and roofs of such adjoining buildings.

2. Should the owner of such adjoining building refuse permission to have his roofs and skylights protected, such

refusal shall be reported in writing to the Superintendent, and it shall then be the duty of the owner refusing such permission to make his skylights and roofs safe at his own expense. Such refusal by said owner shall relieve the owner or person erecting the building from any responsibility for damage done to persons or property on or within the premises affected.

PART XVI.

FIRE DOORS, FIRE WINDOWS AND FIRE SHUTTERS.

Section 88. Protection of Exterior Wall Openings.

1. Every building within the fire limits, except churches and dwellings, shall have approved fire doors, or fire windows on every exterior opening above the first story, when fronting on a street or driveway less than 50 feet wide, or where another building or portion of the same building is within 50 feet of such opening; also all openings in the side and rear walls of the first story, except show windows, when less than 50 feet from another building. The walls of a building in the same plane or parallel planes and facing in the same direction as that in which the opening is situated, shall not be considered as coming within the intent of this rule.

NOTE.—It has been demonstrated many times that the heat from a burning building will break the windows and imperil an exposed building distant even 60 feet or more. The combustibility of the contents of the buildings and the direction of the wind would control results somewhat, but the height of the exposed building would have even greater influence upon its safety.

The difficulty of a fire department maintaining its position in front of a vigorously burning building in a street 50 feet or less in width, with the wind blowing in that direction, is well known. If the fire fighting force cannot maintain such position the danger to the exposed building is apparent, and if the building is over 5 stories high the hazard of the fire entering the windows is greatly increased.

2. All openings in a side wall above and facing on the roof of an adjoining building of other than fireproof construction, shall be protected by fire doors or fire windows to a height of 50 feet above the roof measured in a vertical line. If the adjoining building has a fireproof roof, all openings in the said side wall shall be pro-

tected from the level of the adjoining roof to a height of 50 feet measured in a straight line from the adjacent edge of the nearest skylight or other opening in the adjoining roof, to the top of the opening in the wall.

3. All openings in a side wall above and facing on the roof of a building of other than fireproof construction which is separated from the side wall by a horizontal distance less than 50 feet, shall be protected by fire doors or fire windows from the roof level of the exposing building to a height of 50 feet measured from the top of the adjacent parapet wall to the top of the opening in the side wall; or 50 feet from the adjacent edge of the nearest skylight or other opening in the roof of the exposing building, if the roof be of fireproof construction.

4. All exterior wall openings more than 75 feet above the curb in all buildings, shall be protected by fire doors or fire windows.

5. In business buildings over four stories or 55 feet in height, the windows which are not fire windows, shall have a distance of at least 3 feet between the top of a window sill, and the bottom of the lintel of a window directly beneath. No such window shall be arranged to open within 1 foot of the ceiling surface, but the wall construction between the window opening and the ceiling, may, if desired, be replaced by a fire window in fixed sash and frame.

NOTE 1.—The tendency of fire in a building to travel upwards from story to story by way of the windows is well known. This danger is reduced by separation of the openings through which flames may issue. The National Fire Protection Association recommends 5 feet between windows for a "Standard Building"; such separation is very desirable where it is possible to obtain it. The provision of at least a foot of space between a window head and the ceiling is for the purpose of banking the flames, and deflecting them downward as they escape to the outside air. The hazard can be still further reduced by making the whole upper half of such windows of wired glass in fixed metal sash and frames. Full size fixed windows should be installed wherever possible.

NOTE 2.—The prevalent practice of enclosing factories and some commercial buildings almost entirely with glass, is dangerous. If plain glass be used, the construction is doubly unwise, for an uncontrolled fire in any of the lower stories is sure to

reach the stories above by way of the windows. Even with wired glass the hazard is excessive for it is not a resistant to radiated heat, and there is always serious risk that combustible material in any story will be ignited from that cause.

Protection of exterior openings in mill construction, Sec. 104.

Specifications for test of fire doors, windows and shutters, Sec. 174.

6. Approved fire shutters may be substituted in place of the fire windows required in paragraphs 1, 2 and 3. In such cases at least one row in every three vertical rows of shutters shall be arranged to be readily opened from the outside, and a distinguishing mark satisfactory to the Chief of the Fire Department shall be provided on these shutters.

NOTE.—It is strongly recommended that all window openings exposed to buildings within 15 feet where considerable fire hazard exists shall be protected by approved shutters or outside open sprinklers, in addition to fire windows. The limit of resistance of a wired glass window is reached at about 1,600° F., when the glass will melt and drop from the sash. This temperature is frequently reached in an exposure fire. See also note in Section 104.

7. Occupants of buildings shall close all fire doors, shutters, and windows at the close of business each day.

NOTE.—For complete details of construction and installation of fire doors, shutters and windows, see the "Regulations of the National Board of Fire Underwriters for Protection of Openings in Walls and Partitions against Fire."

Section 89. Protection of Interior Wall Openings.

1. All openings in interior walls shall be protected by fire doors and fire windows where required by this Code, and wherever considered necessary by the Superintendent.

2. In buildings of all classes, all openings into halls or adjoining rooms from rooms in which paints, oils, varnishes, spirituous liquors, or drugs or other highly inflammable liquids or materials are stored for purpose of sale or otherwise; or in which manufacturing processes, or business operations are conducted which are generally recognized as hazardous as regards fire, shall be protected by self-closing fire doors, or fire windows.

This paragraph shall apply to existing as well as new buildings.

NOTE.—It is urged that large quantities of inflammable liquids or materials be stored in isolated small structures. They are a constant menace to life and property when not isolated, and usually incur a penalty in the insurance rates. The subject of regulating the storage of inflammable liquids should properly be under control of the Chief or Fire Department, and should be covered by separate ordinance. See "Suggested Ordinance Regulating Handling and Storage of Inflammable Liquids", issued by the National Board of Fire Underwriters.

Openings in fire walls, Sec. 29, par. 2.

Openings in fire exit partitions, Sec. 47, par. 4.

Openings in shafts, Sec. 90, par. 12 and 13.

Public hallways in tenements, Secs. 284-286.

PART XVII.

PROTECTION OF VERTICAL OPENINGS.

Section 90. Enclosures for Stairways, Elevators, Escalators and Other Shafts in Fireproof Buildings.

1. All interior shafts containing stairways required to be enclosed by Section 45, and except in dwellings, all shafts exceeding 6 square feet in area containing elevators, escalators, hoistways, chutes, ventilating ducts, or used for any other purpose, shall be continuously enclosed with fire-proof walls or partitions built as follows:

Definition of elevator, Sec. 262, par. 1.

- (a) Brick or plain solid concrete not less than 8 inches in thickness for the uppermost 30 feet, increasing 4 inches in thickness for each lower section of 30 feet or part thereof; or 8 inches in thickness for the entire height when wholly supported at vertical intervals not exceeding 30 feet.
- (b) Reinforced stone concrete not less than 6 inches in thickness for the uppermost 30 feet, increasing 2 inches in thickness for each lower section of 30 feet or part thereof; or 5 inches in thickness for the entire height when supported at vertical intervals not exceeding 20 feet and braced where necessary with lateral supports or suitable steel uprights.

- (c) Reinforced cinder concrete not less than 5 inches in thickness for the entire height when supported at vertical intervals not exceeding 15 feet, and braced where necessary with lateral supports or suitable steel up-rights.
- (d) Hollow building tile, not less than 6 inches, or hollow gypsum blocks not less than 5 inches in thickness for the entire height when supported at vertical intervals not exceeding 20 feet, and securely anchored by steel reinforcement encased in the construction.

Hollow building tile shall have not less than two cells in its thickness, with shells and webs not less than $\frac{5}{8}$ inch thick.

All openings in such partitions shall have substantial steel framing, the vertical members of which shall be securely attached to the floor construction above and below.

- (e) Any material and form of construction which may be approved by the Superintendent after a fire and water test as required in Section 174, paragraph 4, but no such partition shall be less than 5 inches thick.

When stair hallway shall be enclosed same as stairway, Sec. 115, par. 7.

Construction of stairs, Sec. 45.

2. Enclosure partitions supporting floor loads shall be of materials and thickness required for bearing walls.

3. Portland cement mortar shall be used for all masonry work in shaft construction, except that gypsum mortar may be used to set gypsum blocks.

Cement mortar, Sec. 56.

Gypsum mortar, Sec. 57.

4. Concrete walls or partitions shall conform to the requirements of the sections on concrete construction.

5. The bottom of such enclosure, and the top when not extended through the roof, shall be of fireproof material not less than 4 inches in thickness.

6. When such shafts extend into the top story, they shall continue through the roof, and shall project not less

than 6 inches above the roof surface. All such shafts shall be enclosed above the roof by at least 5 inches of brick, or stone concrete.

7. Every shaft except smokeproof towers which extends above the roof shall have a thin glass skylight, covering at least three-fourths of the area of the shaft.

Construction of skylights, Sec. 86.

8. All steel used to support shaft enclosures, as required in this section, shall so far as possible, be embedded in the fireproofing material, and shall be protected on all sides, in the manner required for steel in fireproof buildings. See Section 112.

9. When the compartment that contains the machinery for operating an elevator communicates with an elevator shaft, it shall be enclosed with fireproof partitions as required for the shaft.

10. A shaft shall not contain more than two elevators. The separating partitions shall be not less than 2 inches thick.

11. A stairway and elevator shall not be permitted within the same shaft enclosure.

12. All door openings into such shafts shall be protected by fire doors and shall be self-closing except for elevator doors. No glass shall be permitted in such doors, except when doors in elevator shafts open upon an enclosed hallway a wired glass panel not exceeding 1 square foot may be provided in each door. Care should be exercised to insure that all such doors shall fit the opening as closely as practicable.

NOTE.—It is necessary that sliding doors on elevator shafts be made to fit snugly, otherwise in case of fire the shaft fills with smoke and hot gases and becomes untenable and dangerous. The accumulation of such hot gases is very liable to cause an explosion.

In factories and warehouses where elevator shafts open directly into a work or storage room, no wired glass shall be permitted in the doors. The size of such door openings shall not exceed 5 feet 4 inches by 7 feet 6 inches.

13. Windows shall not be permitted in shaft enclosures, except those opening to the outside air, and which

are at least 3 feet distant from any other opening; all such windows shall be stationary or automatic closing fire windows.

14. Where an elevator, escalator, or stairway as required in paragraph (1), connects two floors only in a building, it shall be enclosed in the same manner as for a continuous shaft, except that it may be left open in one story if enclosed in the other. Such elevator or escalator shall not be included in calculations for required means of exit, and no such stairway shall be considered as an exit from more than one floor.

NOTE.—The reasons for excluding elevators and escalators as exits are obvious. The reason for restricting the above described stairway as an exit for one floor only, is that if it were used by people coming from a floor above they would be obliged to pass through the open room at the head of the stairway, and this would be extremely dangerous if that room were afire.

Fire doors and windows, Sec. 88.

Construction of elevators, Sec. 262.

Section 91. Enclosures for Dumbwaiters and other Shafts not Exceeding 6 Square Feet in Area in Fireproof Buildings.

1. All dumbwaiter and other shafts or chutes not exceeding 6 square feet in area, excepting dumbwaiter shafts which do not extend more than one story above the cellar or basement floor in dwellings, shall be continuously enclosed by partitions of brick, building tile, concrete, metal lath and cement plaster, gypsum blocks, or other approved fireproof material not less than 3 inches thick, which may meet the test specified in Section 174, paragraph 4. Such walls or partitions shall rest upon incombustible foundations, and shall be braced between floors with approved incombustible framing. Gypsum blocks may be set in gypsum mortar; all other blocks shall be set in Portland cement mortar.

Definition of dumbwaiter, Sec. 262, par. 1.

2. When dumbwaiter or other small shafts are constructed of blocks, or tile, all corner blocks or tile shall be held by metal angle clips or anchors, or be secured by other approved means.

3. Where a dumbwaiter shaft extends into the cellar or basement of a building, it shall be enclosed in that story with walls of masonry not less than 5 inches thick.

4. The bottom of such shaft shall be of fireproof material, and where such shaft does not extend through the roof, the top of the shaft shall be of fireproof material of at least the thickness of the enclosing partitions.

5. When such a shaft penetrates the roof it shall project at least 6 inches above the roof, and shall be covered with fireproof material and have a skylight covering at least three-fourths the area of the shaft.

Construction of skylights, Sec. 86.

6. All openings in dumbwaiter shafts shall be provided with approved self-closing fire doors.

7. No woodwork other than the guides and car shall be permitted in the construction of any such shaft.

Dumbwaiter shafts in frame buildings, Sec. 190, par. 4.

Dumbwaiter shaft in bakery in tenement, Sec. 305.

Construction of vent flues, Sec. 184.

Section 92. Light and Vent Shafts.

1. The walls of all light or vent shafts, whether exterior or interior, shall extend not less than 3 feet above the level of the roof and be coped.

2. In all buildings other than private dwellings and frame buildings, all windows opening into light and vent shafts shall be protected by fire windows.

Section 93. Enclosures for Stairway, Elevator and Other Shafts in Non-Fireproof Buildings.

1. In non-fireproof buildings of *ordinary construction*, all shafts defined in Sections 90, 91 and 92, shall be constructed as specified in those sections, except as herein provided, and except that the enclosing walls or partitions may be of two cell hollow building tile, or of hollow gypsum blocks, not less than 5 inches in thickness; or 4 inches of reinforced concrete. The thickness of new material permitted under test as specified in Section 90, shall be not less than 4 inches. Such partitions shall be supported by steel structural framework at intervals not exceeding 20

feet. In all respects the reinforcement, bracing, and protection of steelwork shall conform to the requirements of Section 90.

Any woodwork other than guides and car, exposed on the inside of the shaft, shall be covered with metal, or metal lath and $\frac{3}{4}$ inch of cement or cement-tempered plaster, or their equivalent.

2. Dumbwaiter and other small shafts shall be constructed the same as required in Section 91, except as provided in paragraph 3.

3. Every shaft in a non-fireproof building that extends to the top floor shall continue through the roof and at least 3 feet above it, with walls of same thickness as required in the upper story. In all other respects, shafts in non-fireproof buildings of ordinary construction, shall conform to the requirements of Sections 90 and 91.

4. When such partitions rest upon timber construction, they shall be fire-stopped with incombustible material the full depth of the floor beams at each floor level in the manner specified in Section 97, paragraphs 2 and 3. The fire-stopping shall be placed to form a complete cut-off between the interior of the building and the shaft.

Enclosure for stairway and elevator shafts in mill construction buildings, Sec. 109.

Enclosures for stairway and other shafts in frame buildings, Sec. 190, par. 4.

When stair hallway shall be enclosed same as stairway, Sec. 116, par. 4.

Section 94. Shafts and Hoistways in Existing Buildings.

1. All existing buildings over two stories high, which are used above the first story for business purposes or for public assemblage, or for any purpose whatever, if over three stories high, except dwellings, shall have all existing stairway, elevator, and hoistway shafts separately and continuously enclosed by incombustible partitions. Such partitions or enclosing walls, shall be constructed as required in Sections 90 and 93; or in non-fireproof buildings, a 3-inch building tile, concrete block or tile, or gypsum block; or a 2-inch solid metal lath and cement plaster partition; or a 2x4 inch wooden stud partition with 4-inch dimension

at right angles to the wall and covered on each side with metal lath and not less than $\frac{3}{4}$ -inch cement plaster, or by $\frac{1}{2}$ -inch fibre plaster board with filled joints and covered with sheet metal, may be substituted in buildings not exceeding 75 feet in height. Self-closing fire doors shall be used at all openings.

2. If in the opinion of the Superintendent it is necessary to preserve an open elevator or hoistway in an existing building; or if in his judgment the conditions are such that the requirement to enclose would be a substantial injustice to the owner or occupant, the above requirement may be waived; but the floor openings through which the elevator passes shall be equipped with automatically closing trap doors not less than $1\frac{1}{2}$ inches thick, made of two thicknesses of matched boards, covered on the under side with tin; the trap doors when closed shall extend beyond the openings on all sides. Such trap doors shall be protected by a substantial guard or gate, which shall be kept closed at all times except when in actual use.

PART XVIII.

MISCELLANEOUS CONSTRUCTION REQUIREMENTS.

Section 95. Light and Ventilation.

1. In all buildings every sleeping room shall be provided with a window or windows opening directly upon a street, yard or court, except that in dwellings a window shall not be required in a sleeping room which is lighted and ventilated by a skylight; or which is connected by an archway or opening containing not less than 50 square feet in the clear, with a room other than a sleeping room provided with at least two windows of not less than 15 square feet area each between stop beads, and opening directly on a street or yard.

The windows of every sleeping room shall have an area of not less than 12 square feet between stop beads, and the sash shall be arranged to open to the extent of one-half their area. The glass area of skylights for venti-

lating sleeping rooms shall be not less than 9 square feet, and the skylight shall be provided with movable ventilating louvres or sash.

2. In every building, other than a detached dwelling and a dwelling occupied by not more than one family, every sleeping room shall be, for at least two-thirds of its area, not less than 8 feet 6 inches high from the finished floor to the finished ceiling, and shall be not less than 7 feet in width at its narrowest point, and have an area of not less than 70 square feet, except that in hotels, the area shall be not less than 80 square feet.

3. No sleeping room shall be placed in any story the ceiling of which is less than 4 feet 6 inches above the curb or adjacent ground level.

4. Light and ventilation of sleeping rooms in tenement houses shall be as required in Sections 290-293.

Limits of lot area occupied, Sec. 12.

Limits of lot area occupied for tenements, Sec. 239.

Section 96. Floor Lights. Floor lights shall have metal or reinforced concrete frames, and shall be of the same strength as the floors in which they are placed. The glass in floor lights shall be not less than $\frac{3}{4}$ inch in thickness, and if any glass measures more than 16 square inches, there shall be a wire mesh, either in the glass or under it.

Section 97. Fire-Stopping.

1. *Furred Walls.* For all walls furred with wood the masonry between the ends of wooden beams shall project the thickness of the furring beyond the inner face of the wall for the full depth of the beams; or a double course of masonry above and below the beams, shall project the full thickness of the furring beyond the face of the wall. Fig. 20. In cases where floor beams are parallel to a wall furred with wood, there shall be a space of not less than $2\frac{1}{2}$ inches between such wall and the nearest beam. This space shall be filled in solidly with brickwork, or concrete for the full depth of the floor beams.

2. *Studded-off Spaces.* Where walls are studded-off, the space between the inside face of the wall and the studding at the floor level shall be fire-stopped with brick-

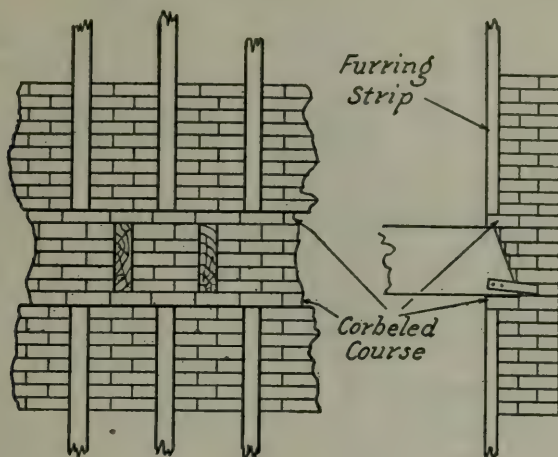


FIG. 20.

Method of fire-stopping wood furred brick walls.

work or other approved fireproof material. The beams directly over the studded-off space shall be deadened with not less than 6 inches of fireproof material, which shall be laid on boards cut in between the beams. The under side of such beams shall be protected by a covering of metal lath, or plaster board, and plastered to a total thickness of $\frac{3}{4}$ -inch.

3. *Partitions.* Where stud partitions rest directly over each other, and cross the wooden floor beams at any angle, they shall run down between the floor beams and rest on the top plate of the partition below, and shall have the studding filled in solid between the uprights the depth of the floor beams and at least 4 inches above each floor level with brickwork or other approved incombustible materials. Such stops shall be arranged to entirely separate the spaces between floor beams and those between partition studs in a manner to effectually cut off draft openings from story to story. Fig. 21.

When sliding doors are pocketed in partitions, care shall be exercised to insure that such pockets be completely fire-stopped at top and bottom.

4. *Wainscoting.* The surface of the walls or partitions behind wainscoting shall be plastered flush with the grounds and down to the floor line.

5. *Stairs.* The space between stair carriages shall be fire-stopped at least once in the middle portion of each run.

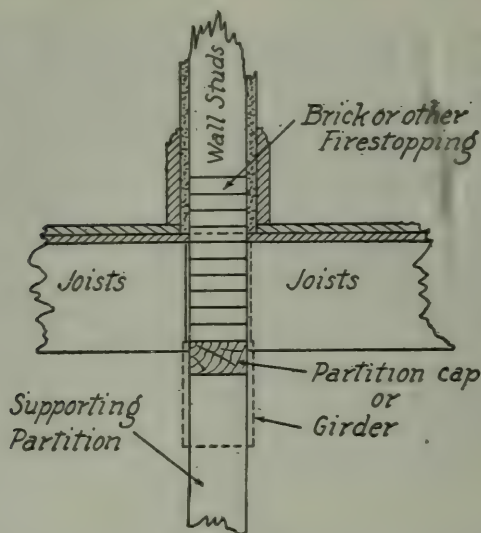


FIG. 21.

Fire-stopping of partitions.

6. No fire-stops shall be covered or in any manner concealed from view until approved in writing by the Superintendent, who shall inspect the same within 48 hours after receiving written notice. Sundays and legal holidays excepted.

7. *Pipes, Shafts and Belts.* All exposed pipes or power shafting passing through any floor or wall shall have the surrounding air space closed off at the ceiling and the floor line; also on each side of the wall by close fitting metal caps. See Note, Sec. 183. In fireproof construction it is preferable to have the pipes or shafts fit neat in the floor or wall.

All belt drives through floors shall be continuously enclosed by steel framework covered with metal lath and cement plaster, or other approved incombustible material. Where possible all such belts shall be placed in a special shaft as required in "Mill Construction," Section 109, (e) paragraph 3.

NOTE.—For details of protective construction for belt drives, see paper in Proceedings of American Society of Mechanical Engineers for 1913—"Protection of Main Belt Drives with Fire Retardent Partitions."

8. *Ducts and Chases.* Ducts, chases, or shafts for

pipes, wires, cables and for similar purposes, shall be constructed as required in Sections 90-93, or shall be fire-stopped at each floor.

Fire-stops around chimneys, Sec. 77, par. 4.

Fire-stops in frame buildings, Sec. 190, par. 5.

Section 98. Requirements in Non-Fireproof Buildings Used for Business and Residence. All ordinary construction non-fireproof buildings of Classes C and D over two stories or 35 feet high, where the lower stories or portions thereof are used for business, and the stories above for residence purposes, shall have all partitions and ceilings separating the business portions from the residence portions, covered with metal lath, or $\frac{1}{2}$ -inch fibre plaster board and plastered with cement or gypsum plaster to a total thickness of $\frac{3}{4}$ inch; or plaster board may be covered with sheet metal. Other equivalent fire-proofing may be used. There shall be no windows in such partitions, and all other openings shall be protected by fire doors.

Stairway, elevator and other shafts in such buildings, shall be constructed in conformity with requirements of Section 93.

Fire-stops shall also be provided at the line of the ceilings to completely cut off all communication to floors above through hollow stud partitions or side walls, as required by Section 97, paragraphs 1, 2 and 3.

NOTE.—Sheet metal, unless backed by an unbroken layer of at least $\frac{1}{2}$ inch of plaster or plaster board, is not considered equivalent to either of the above mentioned methods of protection.

Classification of buildings, Sec. 11.

PART XIX.

CELLARS, VAULTS, AREAWAYS AND PROJECTING STRUCTURES.

Section 99. Requirements for Cellars.

1. *Drainage.* Before the walls of buildings are carried above the first tier of beams, the cellar shall be connected with the sewer and provided with a properly screened intake. Should there be no sewer in the street, or if the

cellar is below water or sewer level, provision shall be made to prevent water accumulating in the cellar, to the injury of the foundation.

2. *Floors.* Any floor laid on the ground shall be made of concrete not less than 4 inches thick. Such floors and the exterior walls shall be waterproofed when required by the Superintendent.

3. *Partitions.* Except in dwellings, and in frame buildings outside the fire limits, all partitions in cellars, excepting partitions enclosing fuel bins, shall be of fireproof construction.

4. *Columns and Piers.* All columns or piers used to support the floor or partitions above, shall be of metal or masonry. If metal columns be used in non-fireproof buildings they shall be protected as required in Section 114.

5. *Ceilings.* All non-fireproof buildings over one story high which are not required by Sections 11 and 271 to have the first floor of fireproof construction, except dwellings shall have the ceiling over the cellar or basement which is nearest to grade level, entirely covered with metal lath and at least $\frac{3}{4}$ -inch of cement or gypsum plaster, or shall be covered with strong fibre plaster boards not less than $\frac{1}{2}$ -inch thick well nailed, and coated with at least $\frac{1}{4}$ -inch of cement or gypsum plaster or with sheet metal.

NOTE.—Cement plaster is the best for this purpose, both as a fire-resistant and as protection against corrosion when metal lath is used.

Ceilings in cellars of frame buildings, Sec. 191.

6. *Shafts.* Stairway and other shafts which communicate with cellars, shall be enclosed as specified for such shafts in Sections 90 to 93, inclusive.

Cellar requirements in tenements, Sec. 271, 288, 310.

Exits from cellar, Sec. 46, par. 5, and Sec. 49.

Section 100. Vaults Under Sidewalks.

1. Where a vault is built under the sidewalk a wall shall be constructed to retain the adjacent banks.

2. The roofs of all vaults shall be of approved incombustible material. Glass, when used in the roofs of the vaults, shall measure not more than 16 square inches in one light.

3. All vaults shall be thoroughly ventilated.

Section 101. Areaways, and Projections Beyond the Building Line.

1. Areaways or openings covered with iron gratings or with iron doors not more than 3 feet in width, with rough surface set flush with sidewalk, may project not more than 4 feet beyond the building line. If gratings be used, they shall have a wire screen of not more than $\frac{1}{2}$ -inch mesh securely attached to the under side.

2. No open areaways, railings, steps, or any portion of a building or structure shall project beyond the building line at any point less than 10 feet above the curb level.

3. Water tables, belt courses, sills, bases, columns, pilasters, capitals or other decorative features which are part of the construction shall not project more than 6 inches beyond the building line. Such projection may be erected only upon a revokable permit issued by the Superintendent when in his opinion such projection will not in any manner obstruct the free use of the sidewalk for travel.

4. No bay, oriel or show window shall project beyond the building line at any point. When erected within the fire limits they shall be constructed of incombustible material, except that on a dwelling such window may be permitted of wooden framework covered with incombustible material, provided it does not extend more than 3 feet above the second-story floor. Cornices of show windows more than 10 feet above curb level may project not more than 18 inches beyond building line.

5. Alterations or repairs to areaways, steps, store fronts, or projecting or show windows shall be subject to the requirements of this section.

PART XX.

"MILL CONSTRUCTION."

The following specifications for Mill Construction are from the 1918 revised Regulations governing such construction prepared by a Committee of the National Fire Protection Association representing the National Board of Fire Underwriters, Associated Factory Mutual Fire In-

insurance Companies, U. S. Forest Products Laboratory, American Institute of Architects, National Lumber Manufacturers Association, and others.

The Regulations are issued by the National Board of Fire Underwriters in booklet form, and supersede the specifications originally printed in this Code. They are given in this the Fourth Reprint of the Fourth Edition as completely as is practical without seriously disturbing the continuity and harmony of the contents, and will be more fully considered in the next edition.

Section 102. Definition. "Mill" Construction (also called "Slow-burning Construction") is a term applied to buildings having masonry walls and heavy timber interior construction with no concealed spaces. Such buildings are usually occupied for factory purposes, and should always be protected by a system of automatic sprinklers, or a combination of automatic sprinklers and standpipes.

1. The limits of height and area shall be as given in Sections 37 and 38, except that the area of floors in buildings three stories or less in height, sprinklered and with non-hazardous occupancy, may be increased, and the area of floors in buildings more than three stories in height and of extra hazardous occupancy and not sprinklered shall be materially reduced.

NOTE.—The insurance inspection department having jurisdiction should be consulted in each case.

Section 103. Foundations and Walls.

1. Foundations shall conform to the requirements of Sections 17 and 18.

2. Outside foundation walls shall be insulated from moisture where necessary.

3. Heavy machines or machines causing strong vibrations shall be supported on foundations independent of those of the main building.

4. Outside walls shall be of brick or concrete and shall conform as to construction and thickness to the requirements of Section 26.

5. Fire and party walls shall be of brick or concrete, and the thickness and construction shall conform

to the requirements of Sections 26, 28, 29 and 30. Parapets shall project to cut-off overhang of roof if any, and special parapets shall be provided where monitors or roof lanterns are near fire walls.

6. Openings in fire walls shall be protected as required in Section 29.

Section 104. Protection of Wall Openings.

1. Openings in exterior walls shall be protected with approved fire doors or shutters, or if the exposure is not too great, approved wired glass windows may be used. The openings to be protected shall be as specified in this section and Section 88.

NOTE.—A wall with window openings protected with shutters is not as good as a blank wall. Where wired glass is used, care should be taken that there is no combustible material near the window that could be ignited by radiation. The very best protection is obtained by use of both fire windows and fire shutters. See also note in Sec. 88, par. 6.

2. Lintels for doors and windows shall be of sufficient strength to carry the respective loads, and, if of steel and over openings more than 4 feet in width, shall be properly fire-proofed.

3. Exterior openings located vertically above one another which are not protected by approved automatic fire windows or doors shall have not less than three feet of solid masonry between the top of any opening and the bottom of the one next above, and no such opening shall be made within one foot of the ceiling of the story in which it is located, provided, however, that part of such masonry below the ceiling may be replaced by wired glass in fixed metal sash and frame.

4. All windows and other openings in side walls of buildings for a distance of at least 10 feet each side of a fire wall, shall be protected as called for in (1).

5. Where main sections are separated by fire walls and adjoin so as to form an angle, all window or other openings in side walls for a distance of not less than 30 feet from the

angle, shall be protected as called for in (1). Where minor sections, such as boiler or engine houses, adjoin, the above rule need apply only to main sections of buildings. Where there are no openings in one section within 10 feet of the fire wall, the other section need not be protected.

6. When buildings of different heights adjoin, all windows of the higher section above the roof of the lower section, as well as all windows within 10 feet of the fire wall on each section, shall be protected as called for in (1).

Section 105. Posts or Columns and Floor Timbers.

1. Posts shall be proportioned in size according to the loads they will carry, but their cross-sectional dimensions shall be not less than 8 inches. All corners shall be rounded or chamfered. In calculating the strength of posts, the net cross-section shall be considered.

2. Posts shall be superimposed throughout all stories on metal caps with brackets, or shall have ends connected by properly designed steel or iron caps, pintle and base plate. Wood bolsters may be used to support roof girders only.

3. Posts shall never rest directly on floor timbers nor on masonry foundations.

4. All girders or floor beams shall preferably be single stick timbers, but if double stick timbers are used, they shall be properly bolted together and contact faces shall be treated to prevent decay.

5. Floor timbers shall be not less than 6 inches (nominal) in either dimension.

NOTE.—In the determination of the dimensions of floor beams special attention shall be paid not only to actual loads to be superimposed, but also to the factor of impact or vibration of machinery.

6. In calculating the strength of beams and columns, the permissible stresses established in the following table shall be used and the net cross section of timbers and not the nominal section shall be considered.

Working Unit Stresses for Timbers Used in Dry Locations.

Species of Timber	Stress in extreme fiber Lbs. Sq.In.	Bending.	Compression	
		Horizontal shear stress Lbs. Sq.In.	Parallel to grain "short columns" Lbs. Sq.In.	Perpen- dicular to grain Lbs. Sq.In.
Fir, Douglas:				
Dense grade	1600	100	1200	350
Sound grade	1300	85	900	300
Hemlock, Eastern	1000	70	700	300
Hemlock, Western ...	1300	75	900	300
Oak	1400	125	900	400
Pine, Eastern White..	900	80	700	250
Pine, Norway	1100	85	800	300
Pine, Southern Yellow:				
Dense grade	1600	125	1200	350
Sound grade	1300	85	900	300
Spruce	900	70	600	200
Tamarack	1200	95	900	350

NOTE.—The safe working stresses given in this table are for timbers with defects limited according to the rules of the United States Forest Service for Select Structural Material. See note page 127(e).

7. Wall plates or boxes of sufficient area and of an approved self-releasing type shall be provided at the ends of floor beams where they rest on walls.

*Proportioning beam ends to load, Sec. 76, par. 5,
Note.*

8. Where wooden beams enter walls at opposite sides, there shall be at least 8 inches of masonry between the ends or sides of these beams, and in no case shall they enter the walls more than is required for sufficient support of the beams; there shall always be 8 inches of masonry from the outside face of the wall to the end of wooden beams.

9. Where girders meet at the columns they shall be fitted around them or butted up close to them. The ends of beams shall be held in place by steel or iron straps spiked, bolted or lag screwed on their sides unless the post caps have sides projecting upwards which can be lag screwed to the beams.

10. Where intermediate beams are necessary for the support of a floor, they shall rest on top of the girders. Where steel or iron hangers are absolutely necessary, the ends of beams shall be fitted in as well as possible, and any interstices between beams framed together shall be filled with a preservative compound.

11. The width of floor bays depends on the layout of the floor, the loads to be carried and the arrangement of the sprinklers; it shall be not less than 6 feet between the centers of the beams.

12. All exposed woodwork shall be planed smooth.

13. Wherever steel beams and columns are absolutely necessary, they shall be fireproofed as required in Section 114.

14. Concrete beams and columns may be used wherever required with wood laminated or plank floors and on condition that the details of supports are properly studied to eliminate dry rot.

Section 106. Floors.

1. The floors shall have the least possible number and amount of openings, and these shall be protected in an approved manner.

2. The floors shall be not less than 3 inches (nominal) splined or tongued and grooved plank covered with 1-inch (nominal) flooring laid crossways or diagonally. Top flooring shall not extend closer than $\frac{1}{2}$ -inch to walls to allow for swelling in case the floor becomes wet. This space shall be covered by a moulding so arranged that it will not obstruct movements of the flooring.

NOTE.—Corbeling of masonry under floor planks is recommended to take place of the above mentioned moulding.

3. If laminated floors are used, at least two laminations at the wall shall be omitted until after glazing and roofing have been completed.

4. Two thicknesses of water-proof paper or saturated felt (but no asbestos) with sealing compound shall be laid between planking and the top flooring, and shall be turned up at least 3 inches around the posts and at the sidewalls. A counter-flashing of galvanized iron or a baseboard nailed in place with the joint between it and the floor covered with a moulding shall protect the upper ends of the water-proofing.

A fairly smooth surface shall be provided before any water-proofing is laid, and the felt or paper shall be laid breaking joints, the joints cemented, and the surface mopped with a water-proof sealing compound. The top flooring shall be laid immediately following the final mopping.

NOTE.—It is recommended that the floors shall have a pitch about one inch in twenty feet to scuppers provided at the floor level, number and spacing to meet the approved requirements.

Drainage of floors, Sec. 110, par. 3.

5. Where plank floors are laid flat, the boards shall be two bays in length if possible and laid to break joints every four feet.

6. Laminated floors, consisting of planks not less than 6 inches wide, set on edge close together and spiked at about 18 inches distance, shall have the joints broken in such a manner that no continuous line will occur across the floor and shall not be spiked to the supporting girders in order to avoid a movement in the girders at the walls due to expansion which may be caused by dampness. Joints to be only at the supports and at the quarter points, with no more than two-thirds at the latter. Joints between the planks of a laminated floor shall be perfectly tight.

7. Pipes or conduits extending through floor shall be provided with tight-fitting metal thimbles having close-fitting metal caps at top and bottom. The thimbles shall be made watertight to a height of 3 inches above floor.

NOTE.—The passage of highly heated air from one story to the story above through floor openings even as small as those between a thimble and the pipe it encases, is recognized by firemen as a serious hazard. Extra precautions should be taken to prevent it.

8. Cellar floor should be of cement or tar concrete laid on a suitable foundation of cinders or broken stone. Cement concrete shall be properly water or damp-proofed as the conditions may require.

NOTE.—Creosoted wood blocks embedded in pitch or asphalt may be used as finish flooring over concrete. Planking three inches thick embedded in tar concrete and having a top or wearing flooring over it may also be used where required.

Section 107. Roofs, Skylights, and Cornices.

1. Roofs shall be of plank and timber construction and either flat or of saw-tooth form.

The pitch of the flat roofs shall be sufficient for proper drainage.

Timber shall be not less than 6 inches (nominal) in either dimension, and preferably shall be single stick and with the edges bevelled.

Plank shall be not less than 2½ inches thick (nominal) splined, or tongued and grooved.

2. Both roof timbers and planks shall be self-releasing at their support on the walls.

3. All exposed woodwork shall be planed smooth.

4. Saw-tooth form of roof and other trusses having iron tension members and other metal connection details shall be permitted only in sprinklered buildings.

5. Roofing shall be of metal, tile, asbestos, coal tar, pitch or asphalt and felt covered with slag or gravel or approved composition.

6. Skylights shall be built according to the requirements of Section 86.

7. Cornices or overhanging gutters of roofs shall be of incombustible material and properly anchored to the masonry walls.

Roof loads, Sec. 40.

Section 108. Partitions.

1. In buildings not more than three stories high, and in all sprinklered buildings, partitions may be constructed of 2-inch matched plank or double matched board with joints broken.

2. All buildings over three stories high and unsprinklered shall have incombustible partitions.

Section 109. Elevators and Stairways.

1. Elevator shafts, not more than 8 feet lateral dimension, shall be enclosed with brick or concrete walls 8 inches thick in buildings not exceeding three stories in height. When buildings are more than three stories in height and the shafts are not more than 8 feet in lateral dimension the walls shall be not less than 8 inches thick for the upper 45 feet and 12 inches for the lower section.

2. Stairways shall be enclosed with brick or concrete walls 8 inches thick in buildings not exceeding three stories in height and when the stairs are of incombustible material; otherwise, the walls shall be 12 inches thick.

Enclosure walls of stairways in buildings more than three stories high shall be not less than 12 inches thick for the upper 45 feet and 16 inches for the lower section.

3. In sprinklered buildings not more than three stories high, stairway enclosure walls may consist of steel or wooden studs having the space between filled with incombustible materials such as plaster blocks or hollow building tile and covered with $\frac{3}{4}$ -inch Portland cement plaster on heavy metal lath and having a total thickness of not less than $5\frac{1}{2}$ inches.

4. A stairway connecting two floors only may be enclosed as specified in paragraph 3, even in unsprinklered buildings.

5. The walls of elevator and stairway shafts when located inside the building shall extend at least 3 feet above the roof. All shafts shall be covered with skylights built according to the requirements of Section 86.

All shaft walls carrying floor load shall be not less than 12 inches thick.

6. All door openings in elevator shafts shall be provided with approved fire doors.

All elevators shall be controlled by some mechanical device that will automatically prevent the car being moved until all shaft doors or gates are closed.

7. Self-closing fire doors shall be required for all stairways, and the arc of opening upon stairway landings shall not reduce the passageway to less than the required width of the stairs.

8. Interior windows in shafts are prohibited.

9. The number and width of exits shall conform to the requirements of Section 44.

Section 109(a). Quality and Kind of Timber.

1. Structural timber shall be free from any form of decay. Sap stain, when the timber is otherwise sound, shall not be considered a defect.

2. For any defects in limited number or size a corresponding decrease shall be made for the allowable stresses used in the calculation of the strength of timber.

3. Girders, beams or posts, of Yellow Pine or Douglas Fir, shall show not less than 85 per cent. of heartwood on

each of the four sides measured across the pieces anywhere in the length.

4. Rough sawed timber shall be not more than $\frac{1}{4}$ -inch, and dressed timber not more than $\frac{1}{2}$ -inch scant of nominal size.

NOTE.—The specifications for timber given in the Appendix, pages 278 to 283, are for general information and are recommended as good practice. Specifications for Douglas Fir will be found in the booklet mentioned in the note at the end of Sec. 109(e).

Section 109(b). Durability.

1. The decay of wood is caused by fungi growths, which thrive in damp, poorly ventilated locations. The prevention of decay in mill buildings can be accomplished by the elimination of excessive moisture by thorough ventilation or heating of all portions. Special care should be given to the design, selection and treatment of lumber to be used under moist conditions.

2. Dry lumber should be used wherever possible and should be well protected from the weather after delivery at the site. The use of green or partially dried lumber, or lumber wet by rain, snow or other causes, may create conditions favorable to rapid decay. This is particularly true of lumber in large beams or that to be used in laminated floors, under which conditions it will dry out slowly.

3. Girders or beams which rest in masonry walls shall not be sealed in; air space of at least $1\frac{1}{2}$ inches shall be provided all around the end to allow proper ventilation.

4. Two brush coats of hot coal tar creosote or other suitable preservative applied to the ends of thoroughly dried timbers will assist materially in preventing decay if conditions are not too moist.

5. Ends of girders, beams and columns when resting on metal plates or masonry shall have the bearing surface protected by a piece of creosote saturated felt or paper, or two brush coats of hot creosote.

6. Creosote or other preservative compound shall be applied also to the ends of columns between floors.

7. No paint or finish of any kind shall be applied to timber before it is dry, preferably one year after the building is completed. Only fire-retardant paint shall be used. Oil, shellac, varnish or similar finishes shall be prohibited except on plastered surfaces in the offices.

8. Care shall be taken if plaster is applied to timber to have the timber thoroughly dry before its application. If plaster is applied to timbers used in a moist location, it is desirable that the timber be thoroughly impregnated with a wood preservative. The plaster shall be porous to permit circulation of air.

Section 109(c). Sprinklers.

Every building more than three stories in height should have all floors, stairways and cellar protected by automatic sprinklers installed in conformity with the requirements of Section 195.

Section 109(d). Extra Hazardous Rooms.

Extra hazardous rooms shall be isolated as much as possible, and shall always be sprinklered. The enclosure of such rooms as well as the floor, ceilings and posts shall be of fire-resistive material.

Section 109(e). Power, Heating and Lighting Installations.

1. A boiler, if placed in the basement of a building, shall be located in an enclosed apartment having brick or concrete walls and fire-resistive floor and ceiling. Openings from boiler room to main building shall be fully protected by approved automatic fire doors; if placed in an exterior building, such building should either be detached at least 25 feet or have exposed or adjoining walls treated as fire walls. Floor of boiler room shall be of fire-resistive material.

2. Uptakes from high pressure boilers shall be not less than 3 feet from all timbers or other woodwork.

3. All belts or rope drives used to transmit power from floor to floor shall be located in a belt tower enclosed as required for elevator shafts Section 109.

Drive shaft holes through walls shall be protected with approved cut-offs.

4. Heating installations shall conform to the requirements of Sections 178-185.

5. Lighting installations shall conform to the requirements of Sections 259-261.

NOTE.—For complete details on Mill Construction, see booklet "Regulations Governing Standard Mill Construction" issued by the National Board of Fire Underwriters.

PART XXI.

FIREPROOF CONSTRUCTION, AND FIRE-
PROOFING.

Section 110. General Requirements for Fireproof Buildings.

1. The walls of every fireproof building shall be constructed as specified in Sections 21-30. The floor and roof construction shall conform to the construction and test requirements specified in Sections 111-113. Reinforced concrete buildings constructed as specified in Part XXII, shall be classed as fireproof construction.

2. The space between the floor arches or slabs and the floor finish shall be solidly filled with concrete as specified in Section 172. The filling beneath wooden flooring shall be made flush with the under side of the floor boards.

3. In buildings of Class E, except stables, also in apartment houses, clubs and hotels, when of fireproof construction, the floors shall be made impervious to water; they shall also be arranged to drain to scuppers or interior drainage pipes, provision being made to discharge water at the rate of 300 gallons per minute per each 1000 square feet of floor area.

NOTE.—This requirement is made on the assumption that in case of a fire there would be at least one hose stream playing upon each 1000 square feet of floor area. A certain amount of such water would find its way naturally to stairway and elevator shafts, but with well constructed shaft doors the flow of water at such outlets would be greatly retarded, except when the doors were open for fire fighting purposes or for other cause. Accumulation of water upon an ordinary floor is sure to produce very serious damage to stock, fittings, and decorations upon all floors below. It is not infrequent that the major portion of the resultant loss from a fire in a fireproof building, is due to water rather than fire. Hollow tile and cinder concrete floor construction as usually installed, leak badly when flooded with water. When a fire occurs in any story of a building having such construction, and considerable water is used to extinguish it, the property loss in stories below due to water is always high unless waterproof floor surfacings are used. The free flow of water through such floors is seriously criticised by firemen. It is not only extremely disagreeable, but it hampers their work and introduces the danger of falling ceilings as well as possibility of overloading floors which are heavily stocked with absorbent material.

Incombustible floor surfacings should be made continuous with the base on all sides of the room to a height of at least 6 inches. Flashings should be provided around all openings through floors except those where a discharge of water would produce a minimum of damage. If scuppers are not desirable to remove surplus water, drainage pipes connecting to gratings located in the base-board or at other suitable points may be provided. When floors have a granolithic finish, care should be exercised to make the mixture as dense as possible. The addition of 10 to 15 per cent. by volume of hydrated lime is recommended to reduce porosity. Wooden floor surfacing should be made as waterproof as practicable. Waterproof paper is sometimes used between the layers of rough and finished flooring, but this increases the danger from dry rot, unless care be exercised to have the sleepers and rough flooring thoroughly dry before sealing it down with the paper. Antiseptic treatment is the most reliable. See Note to paragraph 5. Similar precautions shall be taken around openings through wooden floorings as for other floorings, and the joints between walls or partitions shall be made as tight as practicable. The lowest floor of the building should be provided with adequate facilities for removing surplus water.

Floor drainage for "Mill" Construction buildings.
Sec. 106, par. 4.

4. Except as permitted in Section 45, paragraph 1, all shafts and public hallways shall be enclosed and separated from the rest of the floor space by fire-resistive enclosures, as specified in Sections 90 and 115, and shall have floor surfaces and trim of approved incombustible material. The stairs and stairway landings shall be of approved incombustible material.

5. No woodwork or other combustible material shall be used in the construction of any fireproof building, except wooden floor sleepers, grounds, bucks, and nailing blocks when entirely embedded in incombustible material; also the finish flooring, and all doors and windows when not otherwise specified, with their frames, trim, and casings; also interior finish when backed solidly with fireproof material, may be of wood. Wooden wainscotings more than 3 feet high, or wooden ceilings shall not be permitted.

NOTE 1.—Attention is called to the grave danger of dry rot attacking floor sleepers which are embedded in concrete and then sealed from the air by the floor covering. Instances of rapid decay and serious damage from this cause are numerous. Well seasoned heartwood timber is best suited for this purpose, and antiseptic treatment is recommended. See Note, Section 79. Coal tar antiseptics are not suitable for this purpose in most buildings.

The odor and the oily surfaces are disagreeable, and the danger from fire is increased. Wood treated with zinc chloride or corrosive sublimate is not subject to such criticism.

NOTE 2.—For the highest grade of fireproof building, incombustible surface flooring and metal trim should be used. Buildings of such construction are being erected in numerous cities, and are considered first-class investments.

6. Exterior wall openings shall be protected as required in Section 88.

Section 111. Fireproofing, Floor and Roof Construction.

1. Fireproof construction between steel floor or roof beams, shall consist of segmental arches of brick or concrete, or of segmental or flat arches of hollow building tile, or reinforced cinder, stone, or gravel concrete; or of such other equally fire-resisting material or construction as may be approved by the Superintendent after fire, water, and strength tests.

Specifications for fire tests, Sec. 174.

2. All segmental arches shall have a rise of $1\frac{1}{4}$ inches to the foot of span. Steel tie-rods of proper size, spacing, and location shall be used in all arches to properly resist the thrust. Such tie rods shall be completely encased to a depth of at least 2 inches in fireproofing material which shall extend into and be anchored to the arch.

NOTE.—Tie-rods are an important feature of segmental and flat arch floor construction between steel beams. In general the rods should be placed as near the bottom flanges of the beams as consistent with proper protection by fireproofing. It is good practice to double the number of tie-rods for all outer arches.

Tie-rods in reinforced concrete fireproof construction, Sec. 171.

3. The spacing of floor or roof beams in fireproof construction shall not exceed 8 feet on centers except when the slabs between them are composed of reinforced stone or gravel concrete, in which case they shall be limited by the design according to Section 133, etc.

4. *Brick Arches.* Segmental arches of brick shall have a thickness of not less than 4 inches for spans of 5 feet or less, and 8 inches for spans exceeding 5 feet and not exceeding 8 feet. Brick arches shall be composed of good, hard common or hollow brick. The brick shall be laid to a

line on the centers and properly and solidly bonded; each longitudinal line of brick shall break joints with the adjoining lines. The arches shall spring from suitably designed solid skewbacks made of the same materials as the arches, and be properly keyed. The brick shall be well wet before laying, and the joints solidly filled with mortar.

5. *Hollow Building Tile Arches.* Hollow building tile used for floor or roof arches shall be hard burned or semi-porous and of uniform density and hardness. All hollow building tile arches shall be properly keyed. The key blocks shall always be placed within the middle third of the span.

Segmental arches shall have sufficient depth between the top and bottom faces to carry the load to be imposed, but not less than 6 inches. The tile shall have at least two cellular spaces in the depth.

Flat arches shall have a depth of not less than $1\frac{3}{4}$ inches for each foot of span between the beams, this not to include any portion of the depth of tile that projects below the under side of the beams. The total depth shall in no case be less than 9 inches, and the tile shall have not less than three cellular spaces in the depth.

The shells of arch blocks shall be not less than $\frac{3}{4}$ inch in thickness, and the webs shall be not less than $\frac{5}{8}$ inch in thickness. Every arch block shall have at least one continuous vertical internal web for each 4 inches in width. There shall be rounded fillets at all internal intersections. The skewbacks of all hollow tile arches shall be of such form and section as to accurately fit the beams and properly receive the thrust of the arches, and shall have shells at least 1 inch thick, and webs not less than $\frac{3}{4}$ inch thick.

The safe working load on hollow building tile arches shall be determined by design or by test as specified in Section 175. The allowable extreme fibre stress in compression in hollow clay floor tile shall be taken as 500 pounds per square inch on net section.

Test requirement for floor tile, Sec. 59.

6. *Concrete Arches and Slabs.* All segmental arches or flat slabs of reinforced concrete shall be designed and constructed in accordance with the requirements of this section and of Parts XXII or, XXIII.

7. *Roofs.* Hollow clay or concrete tile, or solid gypsum blocks, may be used for fireproofing between the steel framework of roof construction; but such tile or blocks shall be not less than 3 inches thick, and the supporting steel members shall be spaced not more than 25 inches on centers. When solid blocks or tile are properly reinforced to resist the bending stresses, the steel supporting members may be spaced not to exceed 30 inches apart. The bottom flanges of steel members shall be protected as provided in Section 112, paragraph 6(a).

Thickness of stone concrete roofs, Sec. 137.

Thickness of cinder concrete roofs, Sec. 169.

Roof coverings, Sec. 80.

Section 112. Fireproofing, Protection of Structural Members.

1 *Protection of Wall Columns.* All columns which support steel girders carrying exterior walls, and all columns which are built into walls and support floors only, shall be protected against corrosion by a coating of Portland cement mortar at least $\frac{1}{4}$ inch thick, and against moisture and fire by a casing of masonry, which shall be not less than 4 inches of brick or 3 inches of concrete on all surfaces; all to be well bonded into the masonry of the enclosing walls.

NOTE.—Stonework is not reliable protection for steelwork against fire. A fire of only moderate intensity is practically sure to cause it to be ruined by spalling, and the metal structural members behind it may thereby be exposed.

2. *Protection of Wall Girders.* The wall girders shall have a casing of Portland cement mortar and the same masonry protection as required for wall columns, all to be securely tied and bonded; but the extreme outer edge of the flanges of beams, or plates or angles connected to the beams may project within 2 inches of the outside surface of such casing. The inside surfaces of the girders shall be similarly protected by masonry, or if projecting inside the walls, they shall be protected by concrete, terra cotta, or other approved fireproof material not less than 2 inches thick.

3. All metal structural members which support loads or resist stresses, other than those provided for by the two preceding paragraphs, shall have a protection of fireproofing as herein specified. The protection material shall be brick, concrete, hollow tile, or gypsum block. Concrete shall be of the quality prescribed in Sections 162-168; clay building tile may be solid or hollow, and neither shells nor webs shall be less than $\frac{5}{8}$ inch thick; gypsum blocks shall be solid and of quality approved by the Superintendent. Plaster shall not be considered a part of any required fireproofing for metal structural members except where specifically mentioned as such. See paragraph 8, also Section 114.

4. All bricks or blocks used for fireproofing shall be set in Portland cement mortar, except that gypsum blocks may be set in gypsum mortar. See note to paragraph 5, Section 115.

5. *Interior Columns.*

(a) The protection shall cover the columns at all points to a thickness of not less than 3 inches and be continuous from the base to the top of the column. The extreme outer edges of lugs, brackets, and similar supporting metal may project to within 1 inch of the outer surface of the protection.

(b) If brick or blocks are used for fireproofing columns, they shall be accurately fitted, laid with broken joints, and all spaces between the outside layer and the metal solidly filled with masonry; or a concrete filling may be used. No voids between the metal and the protecting casing shall be permitted.

(c) Galvanized steel wire not smaller than No. 12 gauge, shall be securely wrapped around block column coverings so that every block is crossed at least once by a wire. The wire shall not be wound spirally around the column, but each turn or band shall be a separate unit and shall be twisted tightly or otherwise securely bound. Other equivalent anchorage may be employed if approved by the

Superintendent. No block used for this purpose shall exceed 12 inches in vertical dimension.

NOTE.—Any method which would securely lock the blocks in place, or hold them by substantial interior metal ties, would be superior to the wire wrapping above described.

(d) Columns located in damp places shall receive a coat of at least 1 inch of Portland cement mortar before application of the fireproofing.

(e) Columns made of steel or wrought iron pipe filled with concrete, shall be protected by at least $1\frac{1}{2}$ inches of fireproofing.

(f) Where the fireproofing of columns is exposed to damage from trucking or handling of merchandise, the fireproofing shall be jacketed on the outside for a height of not less than 3 feet from the floor with metal or other approved covering.

6. *Protection of Steel Girders and Beams.*

(a) The protection of the webs and bottom flanges of girders, and all members of trusses shall have a thickness of not less than 2 inches at all points. The protection of the webs and bottom flanges of beams, lintels, and all other structural members shall be not less than $1\frac{1}{2}$ inches at any point.

(b) If hollow building tile be used for protection, the lower flanges of beams and similar members shall be encased either by lugs which form part of the skewbacks and extend around the flanges meeting at the middle; or by tile slabs held in position by dove-tailed lugs projecting from the skewbacks. In either case care shall be taken to insure that all joints be solidly filled with mortar.

7. Concrete protection for all structural members shall be held in position by suitably designed interior steel anchors hooked securely around the flanges or angles of the members, at intervals not exceeding 8 inches apart, these anchors shall be not less than $\frac{1}{8}$ inch in thickness if flat or $\frac{1}{10}$ inch in diameter if of wire, and shall be located at a distance not less than $\frac{3}{4}$ inch, nor more than 1 inch from the outside surface. Fig. 22. Provision shall be made to prevent displacement of anchors while concrete is being deposited. When the flange width of steel members exceeds 6 inches, the wire used for anchoring the concrete protection shall be not less than $\frac{1}{8}$ inch diameter.

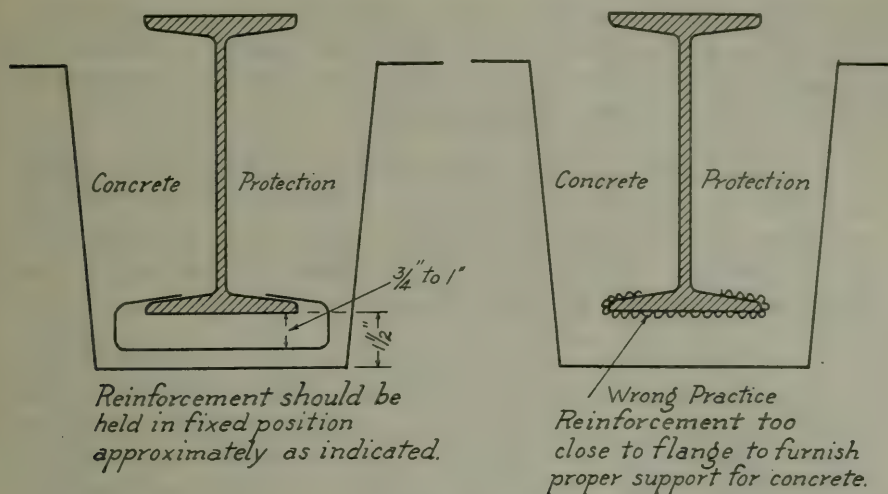


FIG. 22.

Diagrams indicating proper and improper reinforcement for concrete fire protection to bottom of beams.

8. Steel angle or channel struts, or other structural framing not elsewhere provided for, which are used for support in any wall, partition, or other construction, shall be fireproofed as required in this section, or in Section 115, paragraph 4.

9. Metal fronts on the exterior of buildings over one story high shall be backed up or filled in with masonry not less than 8 inches thick.

Section 113. Miscellaneous Fireproofing Provisions.

1. Defective or damaged fireproofing materials shall not be used. All fireproof construction injured or damaged after being erected shall be repaired to the satisfaction of the Superintendent before any filling or finish is placed over same.

2. No pipes, wires, cables or other material shall be incased within or embedded in the required fireproof protection of columns or other structural members.

3. All metal lath and plaster ceilings shall be supported by hangers or clamps attached to the floor or roof construction in an approved manner. Such supports shall be of such section and weight as will support the wet plaster without deflecting more than $1/30$ inch per foot of span.

4. All studding for metal lath partitions or wall furring

shall be made from steel stock weighing not less than 0.5 of a pound per lineal foot, shall be spaced not over 16 inches center to center and shall be securely fastened to the floor and ceiling construction.

5. Metal lath shall be of galvanized steel weighing not less than 54 oz. per square yard. Wire lath shall be not less than No. 20 gauge, and sheet metal lath not less than No. 24 gauge. Metal lath shall be laced to the supporting furring or studs at intervals not exceeding 6 inches.

6. After floors are constructed, no opening greater than 2 square feet shall be cut through them unless suitable metal framing or reinforcing is provided around the opening. After pipes or conduits are in place, all openings around them shall be filled in solidly with fireproofing material unless approved close fitting individual sleeves are provided as specified in Section 97, paragraph 7.

Section 114. Protection of Metal Structural Members in Non-Fireproof Buildings. Steel girders and steel or iron columns which support masonry walls, other than those facing upon a street, shall be protected by at least 2 inches of fireproofing of the same materials and applied in the manner specified in Section 112; or by two inches of metal lath and cement plaster; the latter being applied in two layers with an air space between them. All other iron or steel columns shall be protected by at least 1 inch of metal lath and cement plaster or its equivalent. The lath shall be of quality specified in Section 113, paragraph 5.

NOTE.—The protection of metal structural members in non-fireproof buildings is made obligatory only for members supporting walls and main floor sections which in a fire are likely to collapse suddenly with serious danger to firemen and wrecking of the building.

It is very desirable, however, that other metal members which support important parts of a non-fireproof building, such as roof beams and trusses, should have at least a minimum protection of 1 inch of metal and cement plaster, or other equivalent protective material.

It is well known that steel begins to lose its strength at about 500° Fahr., and at 1,000° Fahr., approximately 70% of its strength is gone. Temperatures such as these are easily reached in an ordinary fire, and if maintained even for a short time are almost sure to produce collapse of exposed steel structural members.

Loaded cast iron columns are very liable to fracture and collapse when highly heated, especially when struck by a stream of water. A simple sub-standard protection as here suggested would prevent such failures, and might easily save a building from complete ruin.

Heavy timber construction will resist collapse from fire better than unprotected steel work. The wooden members will burn and help spread a fire, but it takes considerable time to burn them deep enough to reduce the strength sufficient to cause failure.

Section 115. Partitions in Fireproof Buildings.

1. In fireproof buildings, all partitions enclosing public halls or separating the spaces occupied by different tenants, and all other permanent partitions, shall be built not less than 4 inches thick, of solid or hollow brick, building tile, concrete, or gypsum blocks or tile; or not less than 3 inches thick of reinforced concrete or solid metal lath and cement plaster; or of such other incombustible materials and thickness as shall meet the requirements of the partition fire test as prescribed in Section 174, paragraph 4. The required thickness for block or tile partitions shall be exclusive of plaster. All such partitions shall be securely fastened to the fireproof construction of the floor and ceiling. All bricks, blocks or tile shall be laid with broken joints.

2. All partitions not enumerated above shall be of incombustible materials, except for woodwork permitted in Section 110, paragraph 5.

3. All partitions in fireproof buildings shall be independently supported at each floor level, and where lateral support is not sufficient they shall be stiffened by such steel reinforcement encased in the construction as the Superintendent may require and approve.

4. Structural steel members necessary for supporting a partition, or for framing doorways or other openings through it, shall be protected by at least 1 inch of fireproofing. Cement plaster, or cement-tempered plaster may be accepted for this purpose if properly keyed.

NOTE.—The importance of fireproofing structural framework, or reinforcing members in partitions, must not be ignored or underestimated. It is a fatal weakness in a large proportion of otherwise very sufficient constructions of this class. In nearly every fire of any magnitude, involving high grade construction, fire resistive partitions are rendered worthless by excessive expansion of unprotected steel framework contained in them. In some cases expansion joints in such steel members have been used with success.

5. Reinforced concrete for partitions shall be as required in Sections 120-125 and 162-168. Terra cotta tile shall be porous or semi-porous in quality, and if hollow, shall have two cells in the thickness, with the thickness of shells inclusive of plaster key, not less than $\frac{3}{4}$ inch, and the thickness of webs not less than $\frac{5}{8}$ inch. The shells and webs of hollow gypsum or concrete blocks or tile shall be not less than $\frac{3}{4}$ inch. Gypsum shall be used only in dry locations. Metal lath and studding shall conform to the requirements of Section 113.

NOTE.—Gypsum blocks, or so-called "plaster blocks", or "cinder plaster blocks", have a high percentage of absorption, and when wet they lose considerable of their strength. They should not be used in contact with damp surfaces, or where likely to become wet. Such blocks are also liable to deteriorate when subjected to temperatures in excess of 200° Fahr., for considerable periods of time. They should not be used where such unusual temperatures prevail.

6. All openings in public hallway partitions shall be protected by approved fire doors or fire windows. Approved fire doors may be permitted in a partition separating tenants in a building, but no glass shall be permitted in openings in such partitions.

NOTE.—Openings of any kind in partitions separating tenants are to be avoided wherever possible. They are always a source of danger in case of fire.

7. If a stair hallway be considered as a part of the stairway, and the latter is not separately enclosed as required by Section 90, then the enclosing partitions for the hallway shall be considered as the stairway shaft, and shall be built according to the requirements of Section 90.

8. If the partition surrounding a public hallway be erected in accordance with the requirements for a fire exit partition, it may be considered as a horizontal exit for an occupancy equal to area of the hallway in square feet divided by three.

NOTE.—The requirements for partitions specified in this section, should not be interpreted to exclude the use of cork or other material not readily flammable, when used in refrigeration plants for insulating purposes, and when installed in a manner satisfactory to the Superintendent.

Fire exit partitions, Sec. 47.

Horizontal exits, Sec. 46, par. 2 (c).

Section 116. Fire-resistive Partitions in Non-Fire-Proof Buildings.

1. In non-fireproof buildings of Classes B, C, D, and E, all partitions enclosing public hallways, or separating the spaces occupied by different tenants, shall either be built as required in Section 115, or they may be built of not less than 3-inch approved solid or hollow partition blocks or tile, or by 3-inch hollow or 2-inch solid metal studding and lath with cement plaster, or 2x4 inch wooden studding with metal lath and $\frac{3}{4}$ inch of cement or cement-tempered plaster on each side; or of any other materials and thickness as shall meet the requirements of the partition fire test as prescribed in Section 174, paragraph 4. Wooden studs shall be set with the 4-inch dimension at right angles to the plane of the wall.

2. All such partitions shall be fire-stopped the full depth of the floor beams at each floor level in the manner specified in Section 97.

3. Openings in such partitions shall be protected by fire doors and windows as specified in Section 115.

4. The principles governing hallway partition construction as stated in Section 115, paragraphs 7 and 8, shall apply to the construction of like partitions in non-fireproof buildings, consistent with the requirements of Section 93 for such construction.

Classification of buildings, Sec. 11.

PART XXII.

REINFORCED CONCRETE CONSTRUCTION.

GENERAL REQUIREMENTS.

Section 117. Definition. The term "reinforced concrete" in this code shall mean an approved concrete mixture in which steel is embedded in such a manner as to resist the tensile stresses and to add rigidity and strength to concrete in compression.

Section 118. Approved for all Types of Buildings. Reinforced concrete will be approved for all types of building construction, provided the design conforms with good engineering practice, and the working stresses do not exceed

those herein specified. The construction shall meet the requirements of this Code in all respects, and in addition shall conform to such other rules as may be issued by the Superintendent of Building Construction or State authorities having jurisdiction.

Section 119. Construction Plans and Specifications.

1. The plans and specifications required to be filed with the Superintendent shall be accompanied by stress computations and descriptions showing the general arrangement of the entire construction in all important details, including the size, length, and points of bending of all reinforcement, the qualities, proportions, and methods of mixing the materials used in the concrete and the dead and live loads each floor is designed to carry.

2. All such plans and specifications shall be signed by the architect, engineer, contractor or person applying for the permit. In no case shall the construction deviate from the approved plans and specifications except by written consent of the Superintendent of Building Construction.

SPECIFICATIONS FOR MATERIALS.

Section 120. Quality of Concrete.

1. The concrete shall consist of a mixture of a plastic or viscous consistency of one part of cement to not more than six parts of aggregate, fine and coarse, either in the proportion of one part of cement, two parts of sand and four parts of stone or gravel, or in such proportion as to produce a maximum density. Such concrete shall develop a crushing strength of at least 2000 lbs. per square inch at 28 days when made under laboratory conditions of manufacture; the materials and consistency being practically the same as that used in the field. Test specimens shall be removed from moulds as soon as well set and stored in damp sand until tested.

NOTE.—For important work the best proportions of the component materials should be carefully determined by density experiments and the relative proportions changed to meet varying sizes of fine and coarse aggregate to secure maximum density.

The concrete mixture should be of such consistency that tamping will readily bring water to the surface, but should not be so wet that the coarse aggregate will tend to separate and settle at

the bottom. Excess of water usually leaks from the forms carrying cement with it, thus weakening the concrete, and leaving it porous or "honey-combed".

Weight of concrete, Sec. 63.

Mixing of concrete, Sec. 154.

2. Concrete in the proportion of one part of cement to four and one-half parts of aggregate, which may be desirable for special work such as columns, shall develop a crushing strength of not less than 2,400 pounds per square inch at 28 days, and the working stress of such concrete may be increased 20 per cent. over that permitted elsewhere in this Part.

3. Each test shall consist of a set of at least three duplicate specimens in the shape of cylinders with a height of double the diameter; or cubes having a least dimension of 6 inches. Cubes shall be tested standing on bed and 75 per cent. of the resulting test strength shall be assumed as the strength of the standard cylinder specimen 8 inches in diameter and 16 inches high. The average of the three tests shall be taken as the result for record. The smallest dimension of the test piece should be at least four times the size of the coarsest particle of stone.

NOTE.—The standard form of concrete test specimen generally recommended by testing authorities is a cylinder 8 inches in diameter and 16 inches high. This shape of specimen is advised. Moulds for such specimens are easily made by splitting sections of ordinary stove pipe.

4. In addition to these preliminary tests which are necessary for the purpose of design, the Superintendent may require additional tests to be made upon specimens cast during construction of the building. The test specimens shall be secured at such times and in such portions of the structure as the Superintendent may direct. This test concrete may be taken from the barrows as the concrete is being wheeled to place or from the forms after it is deposited. The results of such tests shall be considered in conjunction with the test of workmanship described in Section 177.

General requirements for tests, Sec. 160.

Quality of cinder concrete, Sec. 167.

Section 121. Quality of Cement. All cement used in reinforced concrete shall be Portland cement meeting the requirements of Section 55.

Section 122. Quality of Fine Aggregate.

1. Fine aggregate shall consist of sand, crushed stone, or gravel screenings, passing when dry a screen having $\frac{1}{4}$ inch diameter holes and not more than 6 per cent. passing a sieve having 100 meshes per lineal inch. It shall be clean and free from quicksand, vegetable loam, perishable organic matter, or other deleterious materials.

NOTE.—Sand with a gradation of grains from fine to coarse is desirable. Silt in sand which contains a small percentage of organic materials, such as vegetable loam, renders the aggregate unfit for use. Clay in small quantities, not exceeding 6%, is not necessarily injurious, and may be beneficial by increasing the density. Pit and stream sands are usually of good quality, but drift sand is ordinarily of too fine a grain to make good concrete. It is recommended that the mesh composition of sand shall be such that 100% passes a $\frac{1}{4}$ -inch mesh sieve; that not more than 75%, and not less than 40%, by weight, passes a 20-mesh sieve; that not more than 30%, and not less than 2%, passes a 50-mesh sieve; and that not more than 6% passes a 100-mesh sieve.

The quality of the sand used in concrete, is as important as the quality of the cement. Failure to recognize this fact has produced many disastrous results.

2. Fine aggregate shall always be tested. It shall be of such quality that mortar composed of one part Portland cement and three parts fine aggregate by weight, when made into briquettes shall show a tensile strength at least equal to the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand, and shall show a tensile strength of at least 180 lbs. per square inch at the age of 7 days. If the aggregate be of poorer quality, the proportion of cement should be increased to secure the desired strength.

NOTE.—Standard Ottawa sand is a natural sand obtained at Ottawa, Illinois, which is prepared and sold by the Ottawa Silica Company under the direction of the Special Committee on Uniform Tests of Cement of the American Society of Civil Engineers. It is graded in size to pass a screen having 20 meshes, and be retained on a screen having 30 meshes per linear inch.

Section 123. Quality of Coarse Aggregate.

1. Coarse aggregate shall consist of crushed stone or gravel which is retained on a screen having $\frac{1}{4}$ inch diameter holes, and shall be graded in size from small to large particles. The maximum size shall be such that all the aggregate will pass through a $1\frac{1}{4}$ inch diameter ring. The

particles shall be clean, hard, durable, and free from all deleterious material.

Aggregates for fireproofing, Sec. 164.

Concrete for footings, Sec. 18.

Mass concrete, Sec. 60.

2. Gravel shall be free from clay or loam except such as naturally adheres to the particles. If clay or loam is in such quantities that it cannot be readily removed by dipping in water or brushing lightly with the hand, the gravel shall be washed. When bank-run gravel is used, it should be screened from the sand and remixed in the proper proportion for fine and coarse aggregate.

NOTE.—It is strongly recommended that all gravel used for reinforced concrete be thoroughly washed. Attention is also especially directed to the fact that quartz gravel is a poor fire-resisting aggregate; crushed granite or sandstone are only fair aggregates for such purpose, while limestone and trap-rock are the best.

Section 124. Quality of Reinforcement. All steel used in reinforced concrete shall meet the requirements of the current Standard Specifications for Billet-Steel Concrete Reinforcement Bars of the American Society for Testing Materials. No reinforcement produced from re-rolled rails or second-hand materials shall be used in any structure without the written permission of the Superintendent. If such reinforcement be permitted, it shall meet the requirements of the current Standard Specifications for Rail-Steel Concrete Reinforcement Bars of the American Society for Testing Materials. Cold drawn steel wire made from open hearth billets of the grade of rivet steel or from Bessemer billets, may be used in floor and roof slabs, column hooping, and reinforcement for temperature and shrinkage stresses. It shall have an ultimate strength of not less than 85,000 lbs. per square inch and test specimens shall bend 180 degrees around their own diameter without fracture.

FACTORS CONTROLLING DESIGN.

Section 125. Allowable Unit Working Stresses. In the design of reinforced concrete structures when the con-

crete is mixed in the proportions of 1:2:4, and satisfies the strength requirements of Section 120, the following working stresses for concrete and steel shall be used:

	Lbs. per Sq. in.
Extreme fibre stress on concrete in compression.	650
Concrete in direct compression.....	500
Shearing stress in concrete when diagonal tension is not resisted by steel.....	40
Shearing stress in concrete when web reinforcement is proportioned to resist two-thirds of the external vertical shear.....	120
• Bond stress between concrete and plain reinforcing bars	80
Bond stress between concrete and deformed bars	100
Tensile stress in steel reinforcement.....	16,000
Bearing on a concrete surface having a total area at least three times the area of the loaded portion, may be taken at $37\frac{1}{2}$ per cent of the ultimate strength of the concrete, when all other stresses are properly provided for.	
Compressive stress in steel as specified in Sections 142, 143 and 144, or in the ratio of the moduli of elasticity of steel to concrete.	
In continuous beams the extreme fibre stress in concrete in compression may be increased 15 per cent. adjacent to the supports.	
In proportioning the section of concrete for shearing stresses, the effective depth from center of compression area to center of steel shall be used.	
Stresses in concrete mixed in the proportions of $1:1\frac{1}{2}:3$ in accordance with Section 120 may be increased 20 per cent in excess of the above stresses.	

Working stresses on concrete in walls, Sec. 147.

Working stress on cinder concrete, Sec. 167, par. 5.

Other working stresses on concrete, Sec. 65, par. 3.

Section 126. General Assumptions. As a basis for calculating the strength of beams and slabs, the following assumptions shall be made:

- (a) A plane section before bending remains plane after bending.

- (b) The modulus of elasticity of concrete in compression remains constant within limits of working stresses fixed in this Code.
- (c) The adhesion between concrete and reinforcement is perfect.
- (d) Concrete has no value in resistance to tension.
- (e) Initial stress in the reinforcement due to contraction or expansion in the concrete is negligible.
- (f) The ratio of the moduli of elasticity of 1:2:4 stone or gravel concrete and steel inflexure shall be taken as 1:15.
- (g) The ratio of the moduli of elasticity of 1:1½:3 stone or gravel concrete and steel inflexure shall be taken as 1:12.

The span length for beams and slabs shall be taken as the distance from center to center of supports, but need not be taken to exceed the clear span plus the over-all depth of beam or slab. Brackets shall not be considered as reducing the clear span in the sense here intended.

Weight of concrete, Sec. 63.

BENDING MOMENTS OF UNIFORMLY LOADED FLOOR AND ROOF SLABS.

Section 127. Bending Moments of Slabs Supported on Two Sides. The bending moments of slabs due to uniformly distributed loads shall be taken as not less than:

1/8 WL, at center when simply supported.

1/10 WL, at center and continuous support when supported at one end and continuous at the other.

1/12 WL, at center and intermediate supports when continuous over more than two supports.

W = Total distributed dead and live loads.

L = Length of span.

Section 128. Bending Moments of Slabs Supported on Four Sides. The bending moments of uniformly

loaded slabs supported on four sides and reinforced in both directions shall be taken as:

- 1/8 WL, at center in each direction when simply supported.
- 1/10 WL, at center and continuous support when continuous over one support.
- 1/12 WL, at both center and supports when continuous over two or more supports.

Section 129. Distribution of Loads. The distribution of loads on square and rectangular slabs supported on four sides, shall be determined by the following formula:

$$r = \frac{l^4}{l^4 + b^4}$$

in which r = the proportion of the load supported by the transverse reinforcement.

l = length of slab.

b = breadth of slab.

If the length of the slab exceeds $1\frac{1}{2}$ times its width, the transverse reinforcement shall be designed to carry the entire load.

BENDING MOMENTS OF UNIFORMLY LOADED BEAMS AND GIRDERS.

Section 130. Term Beam Defined. The term *beam* as used in this part shall be understood to include the term girder, unless specific distinction be made.

Section 131. Beams with simple or Continuous Supports. The bending moments of uniformly loaded beams shall be taken as:

- 1/8 WL, at center when simply supported.
- 1/10 WL, at center and over continuous support when supported at one end and continuous at the other.
- 1/12 WL, at both center and supports when continuous over more than two supports.

Section 132. Beams Supporting Rectangular Slabs.

1. Beams supporting rectangular slabs reinforced in both directions, shall be assumed to take the proportions of load as determined by the formula in Section 129.

2. The bending moments of slabs, beams or girders which are continuous for two spans only, shall be taken as $1/8$ WL over the central support and $1/10$ WL near the middle of the span.

**GENERAL DESIGN REQUIREMENTS FOR BEAM
AND SLAB CONSTRUCTION.**

Section 133. Special Members. The bending moments for slabs or beams with spans of unusual length or due to other than uniformly distributed loads, shall be more exactly computed according to accepted theory.

Section 134. Continuous Floor Construction. In continuous slabs, beams or girders, full provision shall be made for the negative bending moments over the supports by placing sufficient negative reinforcement near the top of the members to resist the stress. This reinforcement shall pass beyond the point of inflection in beams or girders and be anchored in the compression concrete of the member a sufficient distance to develop the full strength of the steel through bond stress. The critical section of continuous construction is over the support.

NOTE.—It is not considered best practice to design a beam as simply supported, with a bending moment of $1/8$ WL at the center, and to provide an arbitrary amount of reinforcement over the support, such as one-half of that at the center.

Section 135. Web Reinforcement in Beams.

1. Members of web reinforcement in beams shall be designed for diagonal tensile stresses, using the calculated vertical shearing stress as a measure of these tensile stresses. They shall not be spaced to exceed three-fourths of the depth of the beam in that portion where the web stresses exceed the allowable value of the concrete in shear. It shall be assumed that two-thirds of the external vertical shear is provided for by the steel in calculating the stresses in stirrups, diagonal web members, and bent up bars; and the remaining one-third of the shear shall be assumed as taken by the concrete, in accordance with Section 125.

2. Web members such as stirrups, when not rigidly attached to the longitudinal steel at both top and bottom, shall be carried around and bent over the longitudinal members or otherwise sufficiently anchored in the compression concrete to develop the tensile stresses existing in them. Diagonal members shall be rigidly attached to the longitudinal steel on the tension side. Stirrups at the ends of continuous girders shall be inverted with the free ends anchored in the compression concrete at the bottom of the beam. The length of stirrups or diagonals embedded in compression concrete shall be sufficient to develop their entire tensile stresses by adhesion.

Section 136. T Beams.

1. Where adequate bond is provided at junction between slab and beam, and the two are cast at the same time as a unit, the slab may be considered as an integral part of the beam, provided its effective width shall not exceed on either side of the beam one-sixth of the span length of the beam, nor be greater than four times the thickness of the slab on either side of the beam; the measurements being taken from line of intersection between slab and beam.

2. In beams with T sections the width of the stem only shall be used in calculating longitudinal shear and diagonal tension. An effective bond shall be provided at the junction of the beam and slab when the principal slab reinforcement is parallel to the beam, by the use of transverse reinforcement extending over the beam and well into the slab.

3. In the design of T beams acting as continuous beams, sufficient compression area shall be provided on the under side at the support, either by the use of properly designed brackets or by embedding additional compression steel in the concrete extending to the point of inflection.

Section 137. Minimum Thickness of Slabs. The minimum thickness of concrete floor slabs shall be 4 inches, and for roof slabs $3\frac{1}{2}$ inches.

Section 138. Floor Finish. Cement or concrete floor finish shall not be considered in calculating the strength of

floor members unless it be laid at the same time they are cast.

Section 139. Composite Floors. The design of composite floors consisting of rows of hard-burned hollow building tile, concrete blocks, sheet steel, or other approved fire resistive material, separated by ribs or beams of reinforced stone or gravel concrete, shall conform to all the provisions of this Part so far as they are applicable. The ribs shall be at least 5 inches wide. The tile or blocks shall be regarded only as fillers, and shall not be considered in the design except as dead load. If designed as a T-beam, the slab portion above the fillers shall be at least $2\frac{1}{2}$ inches thick, and shall consist of the same mixture used for the ribs, and shall be cast at the same time; under these conditions it may be considered in the design of the ribs. Tile or concrete block fillers shall be laid with Portland cement mortar joints, and shall be thoroughly wet before the concrete is poured. The protection for steel bars in bottom of ribs shall be the same as for other beams.

To resist expansion stresses, reinforcement bars not less than $\frac{1}{2}$ inch diameter, shall be placed in the concrete at right angles to the ribs and above the fillers, at intervals not exceeding 30 inches.

DESIGN OF COLUMNS AND WALLS.

Section 140. Length of Columns. The length of columns shall be taken as the maximum unsupported length.

The unsupported length of columns shall not exceed fifteen times the least side or diameter, and in no case shall the least side or diameter be less than 12 inches. The length shall include any corbel or knee brace attached to the column.

Section 141. Columns Without Hoops. Axial compression in reinforced concrete columns without hoops, bands, or spirals, containing not less than $\frac{1}{2}$ per cent., nor more than 3 per cent. of vertical reinforcement, secured against lateral displacement by steel ties placed not farther apart than fifteen diameters of the vertical rods, nor more than 12 inches, shall not exceed 500 pounds per square inch on the effective area of the concrete, plus 6000 pounds

per square inch on the vertical reinforcement. The percentage of reinforcement shall be calculated upon the effective area of the column, which is the area within the reinforcement. Steel ties shall be not less than $\frac{1}{4}$ inch in diameter or least dimension. At least four vertical bars shall be used in every reinforced column, and no bar shall have an area of less than $\frac{1}{4}$ square inch.

NOTE.—Round reinforced concrete columns are better adapted to resist fire than square ones. The latter spall badly at the corners, due to unequal expansion, when attacked by intense heat. A round column or one approximating that shape should be used wherever liable to be subjected to fire. Some authorities advocate the encasing of concrete columns by a protective covering of some material to prevent spalling. Round concrete columns protected by only an inch of plaster on metal lath, are known to have resisted an intense fire excellently; this indicates that even such protection is worthy of careful consideration. In such construction the metal lath should be held securely in place by metal clips anchored into the concrete. Wrapping the lath with wire is not sufficient.

*Strength test requirements for concrete and steel,
Secs. 120 and 124.*

Section 142. Columns With Hoops. Axial compression in reinforced concrete columns with not less than 1 per cent. of hoops or spirals (that is, a volume of steel equal to 1 per cent. of the volume of concrete within the hoops or spirals for a unit length of column) spaced not farther apart than one-sixth of the diameter of enclosed column, but in no case more than 3 inches, with not less than one nor more than 4 per cent. of vertical reinforcement, shall not exceed 750 pounds per square inch on the effective area of the concrete, plus 9000 pounds per square inch on the vertical reinforcement. The hoops or spirals shall be uniformly spaced, and shall be rigidly attached to at least four vertical bars in each convolution.

Columns required to be settled before being built upon, Sec. 157, par. 2.

Section 143. Structural Steel and Concrete Columns. Axial compression in structural steel columns thoroughly encased in concrete having a minimum thickness of 4 inches and reinforced with not less than 1 per cent. of steel (that is, a volume of steel equal to 1 per cent. of the volume of concrete within the hoops) equally divided between vertical reinforcement and hoops or spirals spaced

not more than 12 inches apart, may be taken at 16,000 pounds per square inch on the net section of the structural steel, no allowance being made for the concrete casing. The hoops or spirals shall be placed not nearer than 1 inch from the structural steel, or nearer than $1\frac{1}{2}$ inches from the outer surface of the concrete. The ratio of length to least radius of gyration of the structural steel section shall not exceed 120.

Tests for structural steel, Sec. 62.

Working stresses for structural steel, Sec. 65.

Section 144. Columns Constructed with Special Concrete. In reinforced concrete columns the compression on the concrete may be increased 20 per cent. when the fine and coarse aggregates are carefully selected, and the proportion of cement to total aggregates increased to one part of cement to not more than four and one-half parts of aggregate, fine and coarse, either in proportion of one part of cement, one and one-half parts of sand and three parts of stone or gravel, or in such proportions as will secure the maximum density. The unit stress on the vertical reinforcement in such columns shall not exceed twelve times the unit stress on the concrete.

Section 145. Columns Eccentrically Loaded. Bending stresses in columns due to eccentric loads, shall be provided for by increasing the section of concrete or steel so that the total unit stress shall not exceed the allowable working stress in flexure.

Section 146. Steel Base Plates. Suitable steel base plates or castings shall be provided at the bottom of columns to distribute the loads over the footings, and the vertical reinforcement bars shall bear squarely on these plates, or the reinforcing bars shall be carried down into an enlarged footing to distribute the load through bond stress.

Section 147. Walls. Exterior and interior bearing walls of reinforced concrete shall be securely anchored to all intersecting walls, columns, and floors; and the thickness should be not less than two-thirds that specified for brick walls, and in no case less than 8 inches. Such walls shall be

reinforced with steel running both horizontally and vertically. The amount of reinforcement shall be not less than $1/5$ of 1 per cent. of the cross-section of the wall. Reinforcement shall not be spaced more than 18 inches apart and shall be wired at intersections. Additional reinforcement shall be placed around wall openings and at places where concentrated loads occur. When reinforced concrete walls are made in two parts with an air space between, the effective thickness may in some cases be less than herein specified.

Reinforced concrete partitions, Secs. 90 and 115.

GENERAL PROVISIONS FOR DESIGN OF GIRDERLESS FLOORS OR FLAT SLABS.

Section 148 Girderless Floors.

1. Girderless floors or flat slabs consisting of reinforced concrete slabs resting upon columns with flaring heads, with or without drop heads or column caps, and in which no beams or girders are used, except around openings in the floor or along walls, shall be designed in accordance with the bending moment coefficients and stresses specified in this Code. No empirical formulas based on the results of tests shall be permitted, but the design shall in general be based upon the principles of continuous or cantilever construction as herein indicated.

2. The methods of analysis shall be as follows:

- (a) The portion of the slab adjacent to the column shall be considered as a circular plate supported at the center forming the cantilever portion. The remainder of the slab shall be considered as a simply supported portion suspended from the cantilever plates. The cantilever portion shall be designed for a uniform load over its area equal to the live and dead load on that area plus a concentrated load on its perimeter equal to the floor load resting on the suspended portion of the slab. The radius of the cantilever plate shall be the average distance from the center of the column to the points of inflection of the slab.

- (b) Or the slab may be considered as consisting of a series of continuous broad, flat, girders reinforced with bands of steel consisting of rods supported at the top of the slab over the columns and depressed to the bottom of the slab at the center of the span. These bands of reinforcement may be arranged to run in two directions directly from column center to column center; or in four directions, the former bands being combined with reinforcement running diagonally from column to column.

Section 149. Columns for Girderless Floors.

1. The column capital shall have a diameter or least side at the top in no case less than $0.225 L$ where L is the length of side of the square equivalent to the area of the rectangle included between four adjacent columns. The thickness of the column capital at this diameter shall be not less than $1\frac{1}{4}$ inches. The slope of the column capital shall nowhere exceed an angle of 45 degrees with the vertical.

2. A depressed head or "drop" may be cast above the column capital and the dimensions of this cap shall be not less than 0.4 of the side of the equivalent square panel.

3. The point of inflection shall be assumed $\frac{1}{6} \sqrt{3} L$ from the center of the column.

4. The width of bands shall be such as to properly cover the panel area, but shall not be wider than 0.4 times the side of the square panel. Where steel is provided in two directions only, the central portion of the panel shall be considered as a slab supported on four sides.

5. Punching shear shall be calculated at the edge of the column shaft and shall not exceed 120 lbs. per sq. inch. In computing shearing stress for the purpose of determining resistance to diagonal tension, a point shall be taken at a distance out from the column capital equal to the effective depth of the slab.

6. Working stresses and coefficients shall in general comply with Sections 125, and 127 to 132, inclusive, of this Code. In rectangular panels, the long dimension shall not be more than four thirds times the short dimension. Interior columns shall be capable of resisting the unbalanced bending moment produced by a panel with live load adjacent to a panel without live load. Floor slabs

at walls shall be considered as simply supported on walls or wall beams. If the proportion of the slab adjacent to a wall column is assumed as a cantilever, the wall column or pier shall be capable of resisting the unbalanced moment produced by such cantilever. Bars for negative bending moment shall extend at least to the quarter point of the span, and if the bars have a greater diameter than $\frac{3}{4}$ inch, special attention shall be given to bond and anchorage.

REQUIREMENTS FOR REINFORCEMENT.

Section 150. External and Internal Defects. All reinforcement shall be free from excessive rust, scale, grease, paint or any coating which would tend to reduce or destroy the bond between the steel and the concrete. Bars shall also be free from injurious seams, slivers, flaws, and other mill defects. The weight of any lot of bars shall not vary more than 5 per cent. from the standard weight of the lot as given by manufacturers' handbooks.

Section 151. Placing and Spacing of Reinforcement. All reinforcement shall be accurately located and mechanically secured against displacement during the placing of the concrete. Reinforcement bars for slabs shall not be spaced farther apart than two and one-half times the thickness of the slab. The spacing of parallel bars in beams shall be not less than three diameters from center to center, nor less than one inch. The clear spacing between two layers of bars shall be not less than one inch. In restrained or cantilever construction reinforcement shall extend beyond the supports into adjacent construction for full and effective anchorage, except that when this is not practicable, anchorage shall be obtained by other means acceptable to the Superintendent. Special reinforcement shall be provided to resist concentrated loads. Slabs reinforced in one direction only, shall have shrinkage rods not less than $\frac{1}{4}$ inch in diameter placed above the reinforcement and spaced not over 2 feet apart. All reinforcement shall be assembled well in advance of the placing of the concrete, and shall be inspected and approved by the Superintendent before concrete is deposited.

Section 152. Protection for Reinforcement. Steel reinforcement shall have a minimum protection of concrete on all sides as follows:

In columns and girders, 2 inches; in beams and walls, $1\frac{1}{2}$ inches; and in floor slabs, 1 inch.

The steel in footings for walls and columns shall have a minimum protection of 4 inches of concrete.

Section 153. Splices in Reinforcement. Splices in reinforcing bars shall be designed to transfer the calculated stress at the joint either by bond and shear through the concrete, or by bearing between the steel. Splices at points of maximum stress shall be avoided where possible. Lap splices of bars shall be of sufficient length to develop the required stress in the joint without exceeding the bond stress permitted. In columns where necessary to splice vertical bars having areas in excess of $1\frac{1}{4}$ sq. inches, it shall be done by cutting the bars squarely at the ends and enclosing them in a close-fitting pipe sleeve, or uniting them by a threaded splice or other mechanical connection that will transfer the load from one to the other without stressing the adjoining concrete excessively. The middle point of such splices shall be within one foot above the floor level. Splices in column hooping where necessary, shall be sufficient to develop the full strength of the hooping.

WORKMANSHIP FOR CONCRETE.

Section 154. Mixing.

1. The separate ingredients of concrete shall be accurately measured, and thoroughly mixed in a manner to produce a homogeneous mass of uniform color and of such a viscous consistency that it will flow to all parts of the forms without separation of the coarse aggregate from the mortar.

NOTE.—It is usual practice to consider a bag of Portland cement weighing not less than 94 lbs., as equivalent to one cubic foot.

Quality of concrete, Sec. 120.

2. Except when limited quantities are required, or when the conditions of the work make hand mixing preferable, mixing shall be done in a mechanical batch mixer from which a complete batch shall be discharged before another is received. All ingredients shall be mixed together for at least one minute, the mixer making at least 20 revolu-

tions. The speed of the mixer shall not exceed 20 revolutions per minute. In all cases, the mixing shall be continued until the consistency is constant.

Section 155. Depositing.

1. Concrete shall be deposited, thoroughly tamped and worked to place before initial set begins, and shall then be kept free from shocks and disturbances of every kind until it has fully hardened. Retempering of concrete after its initial set is prohibited.

2. When the work of placing concrete is suspended, all necessary grooves for joining future work shall be made before the concrete sets.

3. Before depositing new concrete upon concrete already set, the contact surfaces shall be roughened, cleaned of all laitance and loose material, and then drenched with water and slushed with a grout consisting of one part Portland cement and not more than two parts fine aggregate immediately before placing the fresh concrete. If a water-tight joint is desired, or if granolithic is to be deposited on old concrete, it is necessary that a neat cement grout be used.

Section 156. Drying and Freezing.

1. When fresh concrete is exposed to rapid drying conditions, precautions shall be taken to keep it moist for a period of at least seven days after being deposited. Where practical this shall be done by a covering of wet sand, burlap or some other equally effective method. Thorough wetting twice a day is recommended.

2. In freezing weather all materials used in making concrete, particularly the coarse aggregate, shall be heated, and precautions shall be taken to prevent the concrete freezing while being deposited; and thereafter it shall be kept above 40 degrees until the concrete has obtained its final set, but such period shall be not less than 72 hours.

Section 157. Joints.

1. Construction joints shall be avoided wherever practicable, but when they are necessary they shall be located at such sections as will least affect the structural strength and shall be made at right angles to the direction of principal

compressive stress. In members of floor systems, joints shall be made within the middle third of the span where practicable. In columns, joints shall only be permitted at the bottom face of the lowest connecting floor members. Temperature changes and shrinkage during setting necessitate joints in independent walls at intervals of 50 to 80 feet when not otherwise provided for by effective reinforcement.

NOTE.—To provide for stresses due to contraction in setting and atmospheric temperature changes in long reinforced concrete buildings, it is customary to construct expansion joints across the buildings at intervals of about 200 feet.

2. Girders, beams, and slabs shall not be cast upon freshly formed columns until a period of 4 to 6 hours have elapsed to permit settlement.

Section 158. Construction of Forms.

1. Forms shall be substantial and unyielding, and care shall be exercised to make them as nearly water-tight as practicable.

2. Care shall be taken to insure that all debris is removed from forms, and that they are thoroughly greased or wetted before concrete is deposited in them. Beam forms shall be so designed that at least one side may be removed without disturbing the bottom portion of the forms and its supports; and column forms, so that they may be removed without disturbing beam and slab forms. Cleanout holes shall be provided in the bottom of column forms where necessary to insure the removal of wood chips or other debris.

NOTE.—It is considered good practice to give a slight camber to forms for beams and girder to overcome the effects of the unavoidable settlement.

Section 159. Removal of Forms.

1. The time for the removal of forms shall always be subject to approval by the Superintendent.

NOTE.—It is recommended that forms shall in no case be removed in less time than fixed in the following schedule, except by written permit from the Superintendent. This schedule presupposes that the concrete has been desposited while the outside temperature was above 40° Fahr., with a rising temperature, and that ample supports are left to carry the construction and any superimposed loads.

Schedule.

Bottom of slabs, spans of 6 feet.....	4 days
plus 1 day extra for each additional foot of span.	
Bottom of beams and girders of ordinary length.....	14 days
Beams of span of 20 feet.....	21 days
Sides of lintels, girders and beams.....	3 days
Columns	3 days
Thin walls	3 days

2. Girders of 25-foot span or over shall be considered as special cases and shall be subject to the inspection of the Superintendent before removal of the supports.

3. Composite floors, same as for ordinary beams.

4. All reinforced concrete shall be carefully inspected to insure its soundness and reliability before main supports are removed.

5. No loads shall be placed upon a reinforced concrete floor before the removal of the form supports, which would in any way tend to overstress such supports or those below.

6. Special care shall be observed in removing forms when the concreting has been done in cold weather. Concrete which has frozen accidentally before setting shall be thawed and kept thawed until it is determined whether the cement will set. In this case, sufficient water shall be provided for the cement to hydrate during this action.

NOTE.—A special permit should be obtained for removal of forms from concrete deposited when the outside temperature was below 32° Fahr., and the number of days required should be increased in proportion to the amount of time the temperature remained below 32° Fahr. after the concrete was deposited.

Section 160. General Requirements for Tests. All tests upon reinforced concrete materials or construction, shall be made in accordance with the requirements of Section 50.

Section 161. Inspection. Every reinforced concrete building shall be erected under the constant supervision of a reputable and competent inspector furnished by the owner or architect, and acceptable to the Superintendent. It shall be the duty of the inspector to keep a daily record of the work done, to observe whether the materials employed and the methods of construction are in all respects in accord with the specifications filed with the Superintendent and the requirements of this Code; and to make record of all varia-

tions therefrom. A copy of these daily reports shall be filed with the Superintendent, who is empowered to stop any improper construction until its faults are corrected, or to cause the removal of any defective work which he may consider dangerous.

A set of plans shall be on file at the building upon which the Superintendent shall mark in ink the progress of the work, and state the time and dates on which concrete for each portion of the structure was deposited; and the Superintendent shall indicate thereon the date upon which the forms may be removed. Record shall also be made of the date upon which forms were actually removed.

NOTE.—For theory of design and allowable practice in reinforced concrete construction, see Report of the Joint Committee on Concrete and Reinforced Concrete, as published by the American Society for Testing Materials.

PART XXIII.

REINFORCED CONCRETE FOR FIREPROOFING.

Section 162. Approved Construction.

1. Concrete is approved for all fire-resistive construction, also for the protection of steel structural members, or for any other fire-proofing purposes in any building.

2. Any system of reinforced concrete construction may be approved for the construction of floor or roof panels, or partitions in skeleton frame or any other type of fire-resistive building, provided that the unit stresses in the materials do not exceed those specified in this Code as permissible for use in such design; and that the concrete and the construction conform to the various other requirements herein specified for such use, including the fire test.

Section 163. Mixture. Concrete for fireproofing purposes shall consist of a mixture of viscous consistency of one part Portland cement to not more than seven parts of fine and coarse aggregate by volume. The aggregate shall be mixed in the ratio of two parts of fine to not more than five parts of coarse, or in such proportions as will give the densest mixture.

NOTE.—A mixture of 1 : 2 : 4 is recommended as giving very satisfactory results. It is particularly advantageous for floor and roof slabs by reason of its density and consequent increase in waterproofness as well as strength.

Section 164. Aggregates. Fine aggregates shall be of quality described in Section 122.

Coarse aggregates shall consist of gravel, crushed stone, hard burned brick, terra cotta, slag, or steam boiler cinders, and shall be clean, hard, and free from deleterious material. All aggregates shall be sized to pass a 1 inch screen and be retained upon a $\frac{1}{4}$ inch screen, and shall be reasonably dry when screened. See warning against quartz gravel, Sec. 123, note to paragraph 2.

Section 165. Manipulation. Concrete for fireproofing shall be mixed, deposited, and protected in accordance with the requirements of Sections 154 to 159, inclusive, of this Code.

Section 166. Reinforcement.

1. The steel reinforcement in concrete used for fireproofing, shall be of quality required by Section 124, and the installation shall be in accordance with the specifications of Section 151. The longitudinal members in mesh reinforcement shall not be spaced more than 4 inches center to center, and the least dimension of mesh opening shall be 2 inches. Mesh metal fabrics of all kinds shall have a side lap of not less than 3 inches.

2. All reinforcement essential to secure the required strength of arches or slabs, shall be fully embedded in the concrete, and shall have a protection of at least 1 inch of concrete on the under side.

3. Exposed metal covering or exposed metal of any kind shall not be considered a factor in the strength of any part of any concrete construction subject to fire; and a plaster finish applied over the metal shall not be accepted as sufficient protection.

Section 167. Cinder Concrete.

1. Cinder concrete may be used constructively as fireproofing, only for floors and roofs between steel beams, and for interior non-bearing walls or partitions.

2. Cinders shall be composed of hard, well burned, vitreous clinker, free from sulphides, fine ashes and foreign matter. The use of gas-house, or locomotive cinders, or stove or heating furnace ashes, is prohibited.

3. In the selection of cinders for concrete, care shall be exercised to insure that they carry only a small percentage of unburned coal or coke. The amount shall not exceed 15 per cent.

NOTE.—Attention is called to the fact that a properly proportioned concrete made from carefully selected cinders is a most excellent fire-resistive material; but the use of inferior cinders or an improper mixture, that is one which is too lean or too dry, may be productive of danger due either to weakness, or liability to produce corrosion of metal in contact with the concrete.

Unburned coal and coke in cinders serve to introduce sulphur into the concrete, which is likely to corrode metal embedded in it unless the concrete is sufficiently wet and rich enough to furnish a coating of cement on the metal. Sulphides will also tend to deteriorate the concrete under conditions of oxidation.

Soft coal cinders should be used with the utmost caution. Satisfactory concrete can be made from clean, thoroughly calcined, soft coal clinker; but soft coal is very liable to carry with it considerable free sulphide of iron (iron pyrites), and cinders from such coal are almost sure to contain an excess of sulphides, which are fatal to good concrete.

4. Cinder concrete in the proportions of 1:2:5 to qualify for use for fireproofing, except when used as fill above the floor arch proper, shall develop an average crushing strength of not less than 800 pounds per sq. inch at 28 days, when tested in accordance with the method of test prescribed for stone concrete in Sections 50 and 120.

5. The allowable extreme fibre stress in compression in cinder concrete slabs between steel beams shall not exceed 300 pounds per sq. inch. The ratio of the moduli of elasticity of 1:2:5 cinder concrete and steel shall be taken as 1 to 30.

NOTE.—Cinder-concrete is very porous, and while this property adds to its fire-resisting qualities, it is a serious defect as regards resistance to water. See Note, Section 110, paragraph 3.

Weight of cinder concrete and fill, Sec. 63.

Section 168. Design Factors for Special Concrete. The allowable working stresses and moduli of elasticity for concrete composed of aggregates other than stone, gravel, or cinders, shall be determined by the Superintendent from results of actual tests.

Section 169. Floor Systems Approved on Design.

1. Segmental concrete arches or flat slabs shall be ap-

proved for fireproofing if designed and constructed in accordance with the requirements of Parts XXII and XXIII insofar as they are applicable; but the permissible stresses for cinder concrete shall be taken as specified in Section 167.

2. The span of concrete arches or slabs for fireproofing shall be taken as the distance center to center of the supporting steel beams, and shall not exceed 8 feet unless the coarse aggregate in the concrete be either stone or gravel, in which case the span shall be limited by the design.

NOTE.—When the span of cinder concrete floor slabs exceeds 6 feet, special care should be exercised in inspecting the details of construction, and the removal of forms.

3. The minimum thickness of arches or slabs of cinder concrete for floor and roof construction shall be $3\frac{1}{2}$ inches, and in no case less than one eighteenth of the span length between supporting beams.

Floor systems approved by test, Sec. 175.

Section 170. Concrete for Principal Bearing Members. Except by written permit of the Superintendent, the coarse aggregate in all concrete used in the construction of bearing walls, columns, piers, or girders, shall be stone.

Section 171. Tie Rods.

1. Segmental arches shall have a rise of not less than $\frac{3}{4}$ inch per foot of span, and steel tie rods of proper size, spacing, and location to resist the thrust shall be used. The rods shall be protected as required in Section 111, paragraph 2.

2. In flat arches, if tie rods are omitted, the reinforcement shall be continuous, or the ends of the bars shall be hooked over the beams or otherwise securely fastened to them at intervals not exceeding 3 feet.

Section 172. Concrete Fill. Concrete for fill shall consist of one part cement and not more than ten parts of aggregate. Aggregates shall be as specified in Section 164. All concrete fill shall be well mixed, thoroughly wet, tamped to place, and brought to a level at the required height. See Section 110, paragraph 2.

NOTE.—Steel or iron pipes or other ferrous metal construction when embedded in cinder concrete fill, should be given a coating of neat cement grout, or be encased in cement or lime mortar as a protection against corrosion. See Note, Section 167, paragraph 3.

Section 173. Protection for Steel Structural Members. Concrete used as fireproofing upon structural steel members shall have the quality, thickness, and be anchored as specified in Section 112.

PART XXIV.

FIRE TESTS OF CONSTRUCTION.

Section 174. Specifications for Fire Tests.

1. None but approved materials or methods of construction shall be used in the erection of fireproof buildings.

2. Fireproof construction and protective devices to qualify for use under test, shall meet the requirements of the following specifications to the satisfaction of the Superintendent.

3. *Fire Tests for Floors.* The fire tests for floors shall be conducted in all respects in accordance with the requirements of the Specifications of the Standard Tests for Fireproof Floor Construction prescribed by the American Society for Testing Materials and which are approved as a Tentative American Standard by the American Engineering Standards Committee.

4. *Fire Tests for Non-Bearing Partitions.* The fire tests for non-bearing partitions shall be conducted in all respects in accordance with the requirements of the Standard Tests for such construction prescribed by the American Society for Testing Materials and which is approved as a Tentative American Standard by the American Engineering Standards Committee. It shall be understood that the tests required in this and the preceding paragraph shall conform to such revisions of the specifications as may from time to time be adopted by the organizations named.

NOTE.—The efficiency of fire-resistance construction depends nearly as much upon its being a poor conductor of heat, as upon its ability to prevent the actual passage of fire. It is recommended

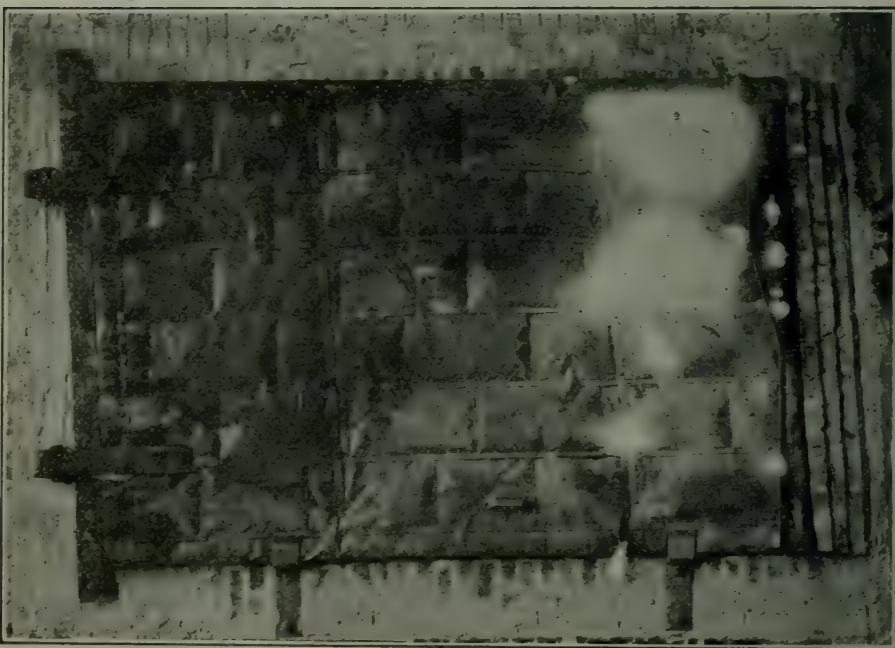


FIG. 23.

Tin-clad fire door immediately after fire test, and before application of water. Fogged spots indicate flames from burning wood gases. Section 174, paragraph 6.

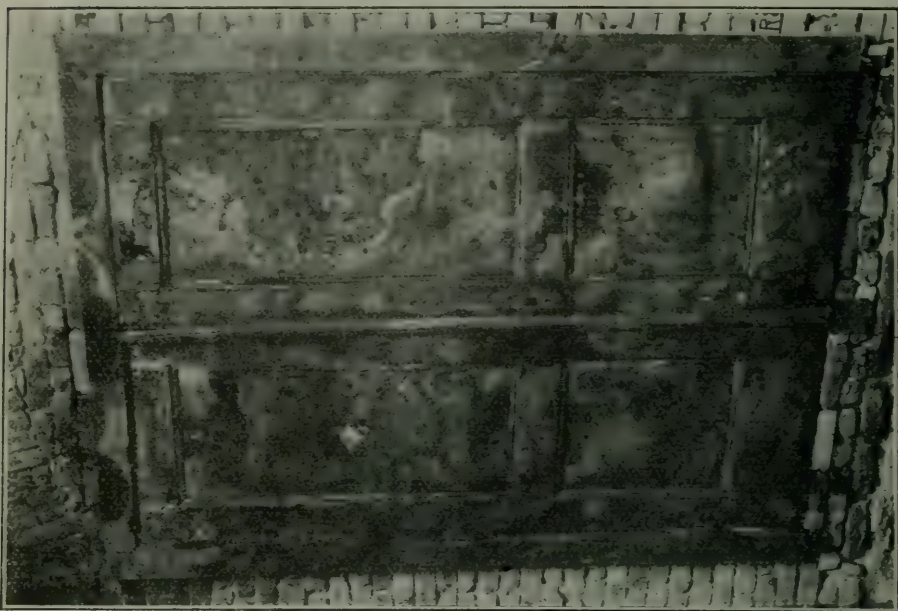


FIG. 24.

Hollow pressed steel door after fire and water test. Doors of this type made both single and double.

that in all fire tests of construction, provision be made for accurately measuring the amount of heat transmitted by conduction. In rating a material or construction for fireproofing purposes, its heat insulating properties should be given due consideration.

5. *Fire Tests for Columns.* The fire tests for columns shall be conducted in all respects in accordance with the requirements of the Tentative Specifications for such tests prescribed by the American Society for Testing Materials, or as they may be revised from time to time by that organization.

6. *Fire Test for Doors and Shutters.* The size of test sample shall conform to the dimensions required for the maximum size of wall opening for which the device is designed up to and including 5 feet by 7 feet, and shall be mounted and hung in every respect as for ordinary service. It shall be subjected to a continuous fire upon one side for at least one hour, the temperature increasing to 1800 degrees F. within 30 minutes, and then rising gradually to a final temperature of 2000 degrees at the end of the hour. Immediately after the expiration of the fire test, while the door is still red hot it shall be subjected to a stream of water from a $\frac{7}{8}$ inch nozzle 20 feet distant from the door and under a pressure of 60 pounds per square inch at the nozzle. The stream shall be kept moving over the test sample for one minute. See Figs. 23 and 24.

A door to successfully pass this test shall not develop serious structural weakness; shall prevent the development of flame on the unexposed side of the door which extend more than a few inches from the door surface; the heat transmitted through or around the door shall not be sufficient to ignite burlap or similar combustible material placed 36 inches back from the door in a room surrounding the unexposed side of the door.

NOTE.—For the purpose of investigating the adaptability of the door frame construction to wall openings of different shapes without involving structural difficulties, it is recommended that the test doorway have an arched top with a rise of about 8 inches.

7. *Fire Test for Windows.* The size of the test sample and the character of the test shall be the same as that prescribed for doors, except that the temperature shall rise gradually throughout the test to a maximum of 1500 degrees F.

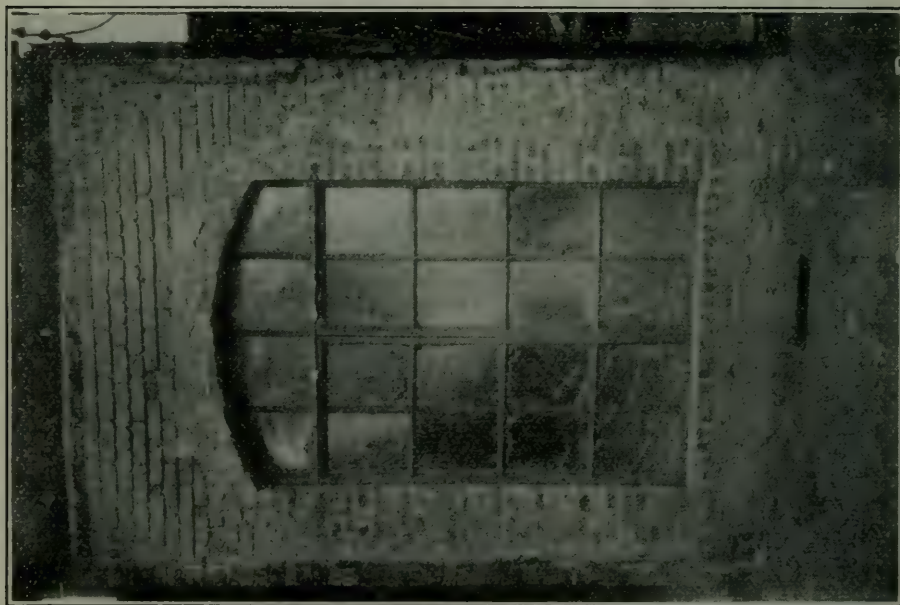


FIG. 25.

A fire window immediately after fire test and before application of water. Note wired glass badly cracked but still in serviceable condition. Section 174, paragraph 7.

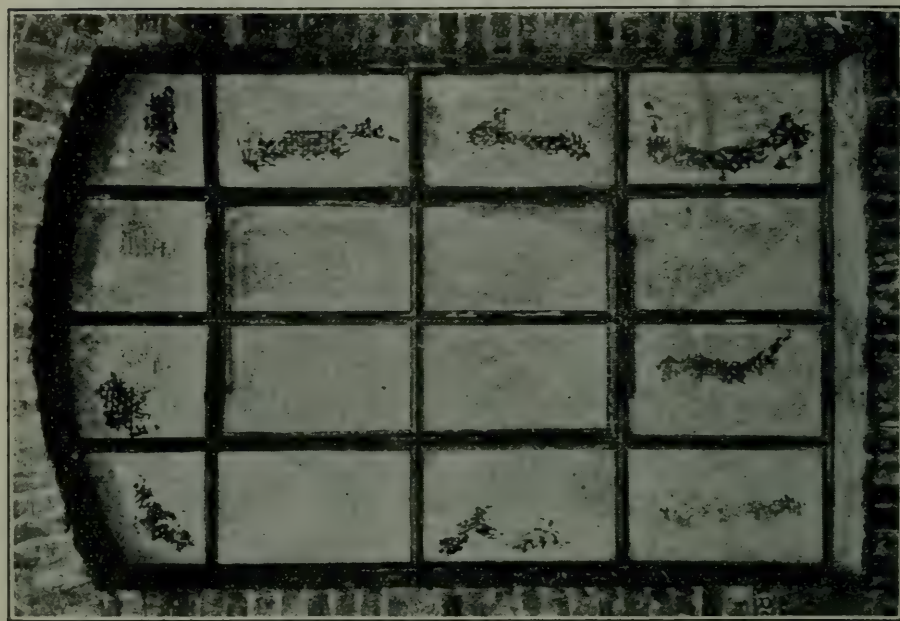


FIG. 26.

A fire window after fire and water test. Note some glass broken away from the wire mesh by force of hose stream.

at the end. The application of water shall be the same as for doors. A test to be successful shall meet the requirements specified for doors, as to structural weakness and passage of flame, but no restriction shall be made as to the amount of heat transmitted through the window; furthermore small portions of glass dislodged by application of the stream of water shall not be considered as structural weakness. The size of wired glass panel, if permitted, in either window or door shall not exceed 720 square inches. See Figs. 25 and 26.

NOTE.—As there are many features in the design of a fire door or window which are important in determining its value aside from the mere application of the fire test, it is recommended that approved devices of this class bear the label of the Underwriters' Laboratories, which insures that each sample has been rigidly inspected in process of manufacture, and that it complied with an established standard of excellence in all details.

8. *Fire Test for Approved Fire-resistive Roofing.*—The roofing test sample shall be applied to a wooden deck made of clear dry white pine boards, spaced at intervals of $\frac{1}{4}$ inch. The test consists of subjecting the sample to fire produced by a brand made of two dry white cedar shingles approximately 8 inches wide and 16 inches long; the shingles to be lapped 4 inches with the grain and 12 inches across the grain, and to be nailed to a $\frac{3}{4}$ -inch pine cleat 12 inches long. See Fig. 27. The test shall be made with the sample at the maximum angle of inclination advocated in practice and while subjected to a wind pressure of from 5 to 8 miles per hour. The brand shall be thoroughly ignited and burning before application to the roof sample, and the latter shall extend on all sides at least 18 inches beyond the extreme edges of the brand. The sample shall resist this exposure without (a) excessive spread of fire from the area directly exposed; (b) the appearance of sustained flame on the under side of deck for a period of 15 minutes after the application of the brand; (c) the blowing or slipping from place of any material part of the roof covering.

NOTE.—This test is merely a crude method of estimating the quality of the lowest grade of roofing permissible within city limits where at all exposed to flying brand hazard. It is by no means as complete and searching as should be employed.

The test does not include a measure of durability, but as the larger part of roof renewal cost is for labor, business economy should insure the selection of a grade of roofing which would not require repair or renewal for a term of years.

The testing and classification of roofings according to their degree of fire-resistance is extremely technical and difficult. It is recommended that only such roofings be used as have been approved after being submitted to the full schedule of test specifications for roofing as applied by the Underwriters' Laboratories. That schedule includes the following tests: Flame exposure, burning brand, and heat radiation tests. Also tests to determine effect of fire streams, physical and chemical tests, and investigations of practicability, durability and uniformity. If interpretation of results from the crude test here specified causes any question of doubt regarding merits of a roofing, a full test by the Laboratories is urged.

The conflagration hazard of inflammable roofs is a most serious menace to every city in which they exist. Ordinary prudence and public safety demand that they cease to be used.

Definition of approved roofing, Sec. 7, par. 3.

Requirements for roofing, Sec. 80.

9. The fire resisting properties of any material or construction other than those already described in this section shall be determined by such tests as meet the approval of the Superintendent.



FIG. 27.

Burning brand test of roofings. Brand in place on sample of roofing. For description see Section 174, par. 8.

PART XXV.

STRENGTH TEST FOR FLOOR CONSTRUCTION.

Section 175. Test of Sample Floor Panel.

1. Any system of fireproof floor construction intended for use between steel beams which is not susceptible of analysis and computation according to the rules of design, may receive approval for use for spans not exceeding 8 feet, on the basis of an ultimate load test as follows:

2. The test shall be under the direction of the Superintendent, and shall be made upon a section of flooring not less than 4 feet wide, and of a span corresponding to the proposed construction. The test load shall be applied at points or loading areas located at the third points of the span. Each loading area shall consist of a zone of the slab surface not exceeding 1 foot in width, and of a length corresponding to the width of the test slab. Rigidity of the steel framework may be secured in any manner acceptable to the Superintendent, but in all cases one end of the test panel shall be constructed to reproduce the conditions of an outside or end panel in a building.

A loose sand bed not over one inch thick may be provided between the floor and the load. Approved methods shall be used for applying the test load and measuring the deformations. The load shall be applied gradually, and a complete record of loads and deformations shall be kept throughout the test. The allowable working load shall be one-sixth the total load causing failure, thus providing for a factor of safety of approximately eight on the basis of a uniformly distributed load. See Figs. 28 and 29.

3. The Superintendent shall keep record of all details of test construction, and approved constructions shall thereafter be installed in every respect in accordance with said record.

4. The application of a test load to a segmental arch may vary from the method given in paragraph 2 if necessary, but any change shall be approved by the Superintendent, and care shall be taken to avoid possibility of arching in the load.

NOTE.—Numerous tests have conclusively demonstrated that it is extremely difficult to apply a uniformly distributed load sufficient to produce the failure of a test section of a strong floor system without arching effect in the loading material rendering results unreliable. It is reasonably certain that many such tests have been made in the past which gave results that were fictitious to a degree quite unsuspected by the experimenters. For this reason it is necessary that test loads upon floor panels shall be concentrated either at the middle of the span or at certain specified points and then calculate equivalent distributed load. While a correct result by uniform loading is possible, the many practicable difficulties in accomplishing such a test renders it almost prohibitive. The method of loading flat panels given in paragraph 2 is simple and reliable.

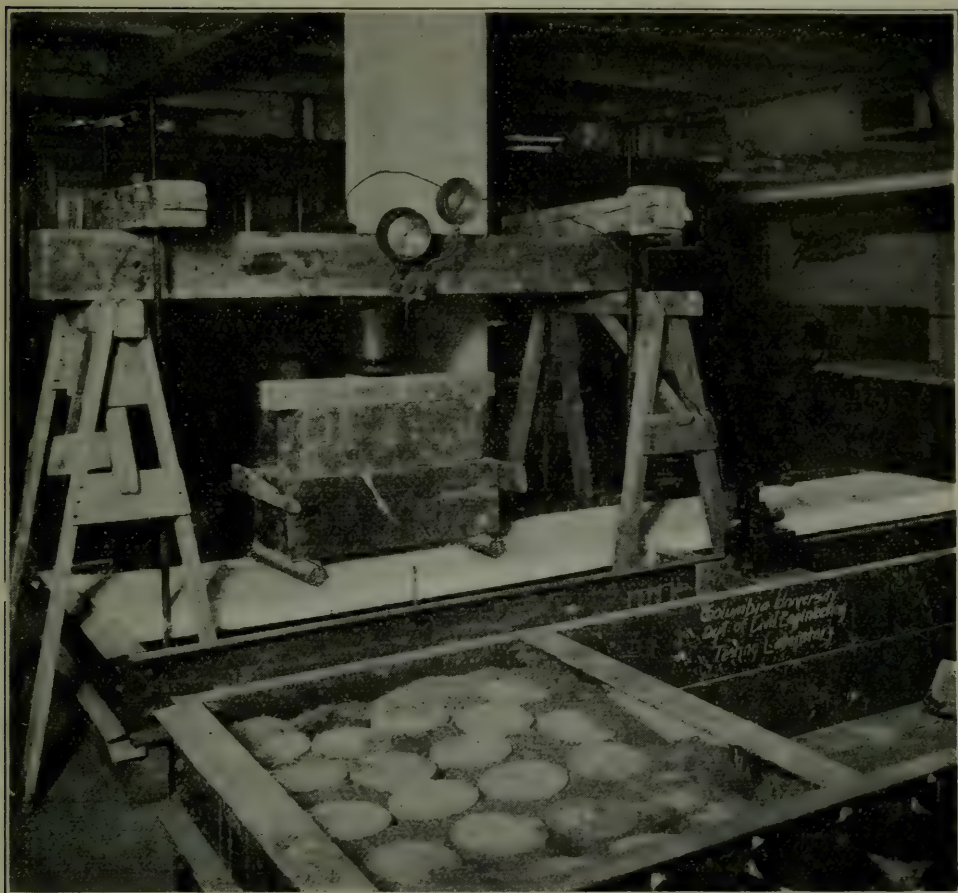


FIG. 29.

Laboratory test of concrete floor panel; load supported at third points of span, and applied by hand pump and hydraulic plunger. One end of slab is freely supported and there is an anchor span at the other; a typical end-panel construction.

Note concrete compression specimens stored in moist sand in foreground.

supported on the steel beam, and the other end made continuous by installing a span equal to the test span in length and thickness, and embedding the reinforcement therein in the usual manner. See Figs. 28 and 29.

The test construction shall be 30 days old on the day of the test.

NOTE.—For a clearer understanding of the effect upon the bending moments and shears produced by this system of loading, as compared with uniform loading, see calculations and diagrams on pages 293 and 297 of the Appendix.

Test of workmanship for floor construction, Sec. 177.

Section 176. Test of Systems of Construction. When a construction engineer, contractor, or builder proposes new methods or principles in combining concrete, steel or other structural materials, not provided for by this Code; or designs a construction in which the stresses are indeterminate, he shall furnish for record with the Superintendent, plans and specifications giving in detail the construction and calculations used in his design. He shall also prepare a sample portion of the construction and submit it to an ultimate load test in a manner satisfactory to the Superintendent; or the Superintendent may accept satisfactory evidence that such test has been made upon the particular system proposed. Such evidence shall comprise full details of a test and the results, and shall show the deflections and other effects on the construction at all steps during the test. If the test shows that the construction, based on specifications submitted, has a factor of safety of four on total dead and live load, and that the design, stresses, and coefficients specified by this Code are not exceeded, and it otherwise meets the approval of the Superintendent, he shall issue regulations under which such construction may be used. No such regulations, however, shall have the effect of altering the working stresses and the requirements for fireproofing specified in this Code.

Section 177. Test of Workmanship for Floor Construction.

1. Whenever the Superintendent of Building Construction has doubt as to quality of materials or workmanship in any building, he may require the owner or contractor at his own expense to make such tests as will establish the safety of the construction before certificate of occupancy is issued.

Certificate of occupancy, Sec. 8.

2. The test shall be under the direction of the Superintendent, and shall show that the construction will safely sustain a load equal to twice the live load for which it was designed, for a period of 24 hours without injury or permanent deformation. In the test of a floor arch the load shall be applied to a typical arch of average span between beams. If less than a whole arch between girders is tested, the test section shall be cut apart or isolated from the rest

of the arch before applying the load ; such test section shall have a width of at least 4 feet measuring parallel to the beams.

3. The load shall consist of such materials and shall be so placed as to form a uniformly distributed load over the entire area to be tested without arching effect. In case sand or similar material is used for loading, it shall be loose in bottomless bins, and not in sacks or packages of any kind. A complete record of loads and deformations shall be kept throughout the test.

4. At least 30 days shall have elapsed after removal of forms from concrete flooring before a test load is applied.

5. If the portion tested should fail to meet the requirement of this test, the Superintendent may still approve the structure for use, and if necessary tests shall be repeated on different portions to determine the critical load. The detail records of this test, and the results of the tests upon the samples of concrete used in the construction, shall be taken into consideration by the Superintendent in determining the working load to be permitted. However, it shall be specifically understood that no sub-standard construction shall be accepted by the Superintendent, if in his judgment it is sufficiently defective to be unsafe for the purpose intended.

Test of sample floor panel, Sec. 175.

Strength tests for materials, Sec. 50.

PART XXVI.

CHIMNEYS, FLUES AND HEATING APPARATUS.

Section 178. Chimneys, Smoke Flues, Gas Flues and Fireplaces.

1. All chimneys hereafter erected shall be of brick or stone laid in Portland cement mortar reinforced concrete or other approved incombustible material, extending at least 3 feet above the point of contact with a flat roof or 2 feet above the ridge of a pitch roof, and shall be properly capped with terra cotta, stone, cast iron, or other approved incombustible weatherproof material.

NOTE.—For complete details of chimney construction, see "An Ordinance for Construction of Chimneys," issued by the National Board of Fire Underwriters.

Composition of cement mortar, Sec. 56.

2. The brickwork or reinforced concrete of the smoke flues of all boilers, furnaces, baker's ovens, large cooking ranges, large laundry stoves, and all flues used for a similar purpose shall be at least 8 inches in thickness. Walls of smoke flues used exclusively for ordinary stoves or open fireplaces shall be not less than 4 inches thick. Brick set on edge shall not be permitted in chimney construction.

3. Where two or more smoke flues are contained in the same chimney, the walls between the several flues shall be not less than 4 inches thick. The walls of stone smoke flues shall be 4 inches thicker than required for brick or reinforced concrete. No smoke flue shall have smoke pipe connections in more than one story of a building.

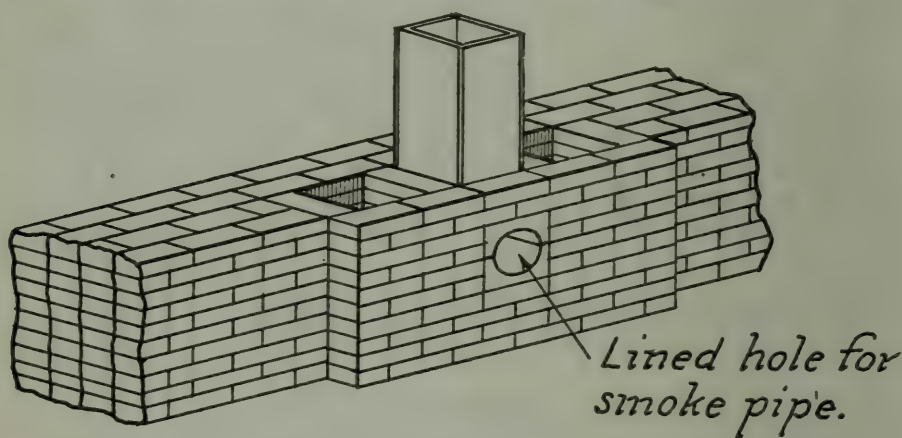


FIG 30.

Method of building in flue tile during construction of chimney in a wall.

4. Every smoke flue contained in a chimney hereafter erected shall have an area of at least 64 square inches and, unless required to be lined with fire brick, shall be lined with hard burned terra cotta or fire clay flue lining made smooth on the inside. The flue lining shall start from the bottom of the flue, or from the throat of the fireplace if the flue starts from a fireplace, and shall be carried up continuously the entire height of the flue. If the thickness of the masonry surrounding the throat be less

than 8 inches in any part, the lining shall start at bottom of the lintel. The ends of the sections of all such lining tile shall be laid in cement mortar and the tile shall be built in as the flues are carried up. Fig. 30.

No parging mortar nor plaster shall be used on the inside of any fireplace, chimney, or flue.

NOTE.—While walls 4 inches thick and lined are permitted for chimneys serving as flues where high temperatures are not maintained, a minimum wall thickness of 8 inches is strongly recommended, especially in localities subject to severe winters, and continuous hot fires are a necessity.

5. In every building, where one or more smoke flues start from the cellar or lowest story, at least one such smoke flue shall have an internal cross-sectional area of at least 96 square inches and shall start at least 3 feet below the ceiling.

6. In no case shall a chimney be corbeled more than 8 inches from the wall, and such corbeling shall consist of at least five courses of brick. Piers which support chimneys shall start from the foundation on the same line with the chimney breast. They shall be not less than 12 inches on the face and shall be properly bonded into the walls. No chimney shall rest upon, nor be carried by woodwork. No combustible furring or sheathing shall be placed against any smoke flue or chimney breast.

7. The walls of flues used only for gas burning appliances shall be of brick or concrete at least 4 inches thick and lined as required in paragraph 4 of this section. Where two or more such flues are contained in the same chimney, the walls between the several flues shall be not less than two thicknesses of the tile lining with joints broken, except that at least every third partition shall be not less than 4 inches thick of brick or its equivalent, and bonded into the walls. Not more than one appliance or utensil in which gas is used as fuel shall be connected to a single flue, nor shall any such appliance or utensil be connected to any flue to which a smoke pipe is connected.

8. The smoke flue of every high pressure steam boiler and every appliance producing a corresponding temperature in the smoke flue shall, if built of brick, stone, reinforced concrete or other approved masonry, be lined on all sides

with not less than 4 inches of fire brick laid in fire mortar for a distance of at least 25 feet from the point where the smoke connection of the boiler enters the flue.

9. Interior vertical smoke stacks or flues for steam boilers or other furnaces, and similar heating devices producing a corresponding temperature, may be of metal not less than No. 10 U. S. gauge, properly riveted, jointed, and braced at intervals of at least 20 feet. Such stacks shall either be enclosed by approved masonry walls not less than 8 inches thick with an air space of at least 4 inches between lining and wall; or if such stacks or flues are not enclosed with masonry they shall have a clearance from all combustible material of not less than one-half the diameter of the stack, but not less than 24 inches, unless the combustible material be properly guarded by loose fitting metal shields, in which case the distance shall be not less than 12 inches. Where such a stack passes through a wooden framed roof, it shall be guarded by a galvanized iron ventilating thimble extending from at least 9 inches below the underside of the ceiling or roof beams to at least 9 inches above the roof, and the ventilating thimble shall have a clearance of not less than 18 inches, except that for stacks for low grade furnaces such as hot air, hot water, and low pressure steam heating furnaces, coffee roasting ovens, candy furnaces, etc., the clearance may be reduced to 12 inches. Metal smoke stacks shall not be permitted to pass through floors. Smoke flues shall not be permitted inside of vent flues for ranges.

Protection for vent flues and ducts, Sec. 184.

10. Exterior metal smoke flues for boilers, large cooking ranges, and similar heating devices, shall be of approved construction and supported on approved masonry foundations, and shall have a clearance of at least 4 inches from an outside incombustible wall. Such flues having an area not exceeding 255 square inches shall be constructed of not less than No. 16 U. S. gauge metal; if the area exceeds 255 square inches the thickness of the metal shall be not less than No. 10 U. S. gauge.

11. The smoke flue of every smelting furnace, and of every other similar device which heats the flue to an extremely high temperature, shall be built with double walls of thickness suitable for the temperature. There shall be

an air space between the walls, and the inside wall shall be of firebrick not less than 4 inches thick.

12. Chimneys of cupola-furnaces, blast-furnaces, and similar devices, shall extend at least 10 feet above the highest point of any roof within a radius of 50 feet, and no woodwork shall be within 3 feet of any part of any such device or its chimney.

13. When a building or structure extends more than 10 feet above the roof of an adjoining building or structure, the owner of the higher building, if requested in writing during its construction by the owner of the adjoining building or structure, shall at his own expense extend the adjoining flues of such adjoining building to the same height as the chimneys of his building, or shall supply sufficient flues connecting such adjoining flues with the chimneys of his building.

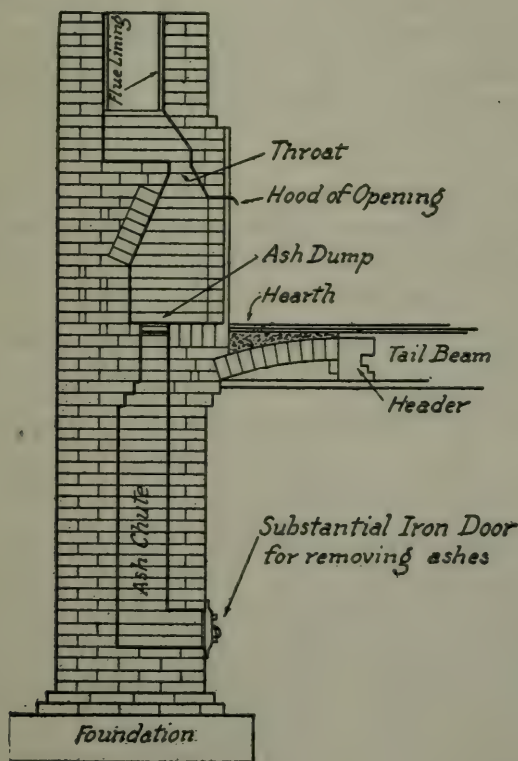


FIG. 31.

A thoroughly safe and substantial form of fireplace construction.

14. All fireplaces and chimney breasts where mantels are placed, whether intended for ordinary fireplace use or not, shall have trimmer arches or other approved fireproof construction supporting hearths. The arches and hearths shall be at least 20 inches in width measured from the face of the chimney breast, Fig. 31. The arches shall be of brick, stone, hollow tile or reinforced concrete of approved thickness. The length of the trimmer arch and the length of the hearth shall be not less than the width of the chimney breast. The hearth shall be of brick, stone, tile or other approved fireproof material. False fireplaces shall only be permitted against unfurred masonry walls.

15. No coal burning heater shall be placed in a fireplace which does not conform to the foregoing requirements and have an incombustible mantel. No wood mantel or other woodwork shall be placed within 8 inches of the side nor within 12 inches of the top of any open fireplace. No combustible summer piece or fireboard shall be used in connection with any open fireplace. The firebacks of all fireplaces shall be of solid masonry not less than 8 inches thick.

16. When a grate is set in a fireplace, a lining of firebrick at least 2 inches in thickness shall be added to the fireback, or soapstone, tile or cast iron may be used, if solidly backed with brick or concrete.

All flue-holes when not in use shall be closed with tight-fitting metal covers.

Protection of woodwork around chimneys, Sec. 77.

Section 179. Smoke Pipes.

1. No smoke pipe shall pass through any floor, nor through a non-fireproof roof. Smoke pipes for large cooking ranges, hot air furnaces, low pressure steam or hot water boilers, shall be not less than 18 inches below any wood lath and plaster or other combustible ceiling, unless at least the upper half of such smoke pipe is properly protected by 1 inch or more of asbestos covering or its equivalent, or by a metal casing spaced 2 inches from the upper half of the pipe. If so protected smoke pipes shall be not less than 9 inches from any wood lath and plaster construction, wood-

work, or other combustible material. Smoke pipes from ordinary stoves shall be not less than 9 inches from any exposed woodwork.

2. Where a smoke pipe passes through a wood lath and plaster or other combustible partition or wall, a section of the partition or wall shall be removed and the smoke pipe so placed that no part of it shall be nearer than 6 inches to any remaining combustible part of the partition. The section of the partition or wall so removed shall be replaced by approved fireproof material only, and an air space of at least 2 inches shall be preserved on all sides of the smoke pipe.

Section 180. Heating Furnaces and Appliances.

1. High pressure steam boilers, bakery ovens or furnaces in which fires are maintained producing a high degree of heat, shall rest on the ground, a trimmer arch, or a fireproof floor constructed in accordance with Section 111.

2. Low pressure heating boilers, coffee roasters, fire-heated candy kettles, laundry stoves, coal ranges without legs, and similar appliances where hot fires are used, shall rest upon fireproof foundations as above described. However, the Superintendent's written permission may allow them to be placed upon wooden floors if the floors are protected by sheet metal or a $\frac{1}{8}$ inch layer of asbestos building lumber, covered with not less than 4 inches of masonry set in cement mortar. Such masonry shall consist of one course of 4 inch hollow tile or of two courses of brick or tile, at least one of which shall be hollow and be laid to preserve a free circulation of air throughout the whole course. Concrete may be substituted for a course of solid brick if desired. The masonry work shall be covered by sheet metal of not less than No. 26 gauge, so arranged as not to obstruct the ventilating passages beneath; or the heating appliances may rest upon 6 inch foundations built of incombustible materials supported within the thickness of the floor framing. Such hearths shall extend at least 12 inches on the sides, back, and front of the furnace, range or similar heating appliance; if solid fuel is used, the front extension shall be at least 24 inches.

All stoves or ranges with legs shall be set on incombustible material which shall extend at least 24 inches in front when solid fuel is used.

NOTE.—Solid brickwork will conduct heat quite freely. There are records of numerous fires starting by the ignition of wooden flooring underneath single layers of brick which supported furnaces or ranges in which hot fires were maintained. Hence the necessity for the double layers and air space.

3. Any woodwork or wooden lath and plaster partition within 4 feet of the sides or back, or 6 feet from the front of any such boiler, furnace, or heating appliance, shall be covered with metal shields or other approved incombustible material to a height of at least 4 feet above the floor. This covering shall extend the full length of the boiler, furnace, or heating appliance, and to at least 5 feet in front of it. Such metal shields shall be so attached as to preserve an air space behind them. In no case shall such combustible construction be permitted within 2 feet of the sides or back of the heating appliance, or 5 feet in front of same.

4. Heating boilers shall be encased on sides and top by incombustible protective covering not less than $1\frac{1}{2}$ inches thick, and the overhead clearance of such covered boilers and hot air furnaces shall be not less than 15 inches. Any woodwork within 2 feet of the top of such boilers or furnaces shall be protected by a loose fitting metal shield, but such shields shall not be placed so as to form concealed spaces.

NOTE.—It is recommended that the room or rooms in which boilers and all power and operating machinery are located, shall be separated from other portions of the building by an 8-inch wall, having an approved fire door at each opening; such rooms not to have direct communication with the floor above.

Sprinklers over boilers, Sec. 195, par. (e).

Section 181. Stoves and Ranges.

1. No kitchen range or stove in any building shall be placed less than 3 feet from any woodwork or wooden lath and plaster partition, unless the woodwork or partition is properly protected by metal shields, in which case the distance shall be not less than 18 inches. Metal shields shall be so attached as to preserve an air space behind them.

2. Hotel and restaurant ranges shall be provided with a metal hood placed at least 9 inches below any wooden lath and plaster or wooden ceiling, and have an individual pipe outlet connected with a flue in accordance with the re-

quirements of Section 184. The pipe shall be protected by at least 1 inch of asbestos covering, or its equivalent.

3. No furnace, boiler, range or other heating appliance shall be placed against a wall furred with wood.

Section 182. Hot Air Pipes and Registers.

1. All stone or brick hot air flues shall be lined with tin or other suitable sheet metal or burnt clay pipe.

2. Horizontal hot air furnace pipes shall be placed at least 6 inches below wooden floor beams or wooden lath and plaster ceiling; if the floor beams or ceiling are protected by metal lath and plaster, or if the woodwork be covered with loose fitting tin, or the pipe be covered with at least $\frac{1}{2}$ inch of corrugated asbestos, the distance from the woodwork may be reduced to not less than 3 inches.

Cross-section Through Stud Partition Showing Hot Air Pipe

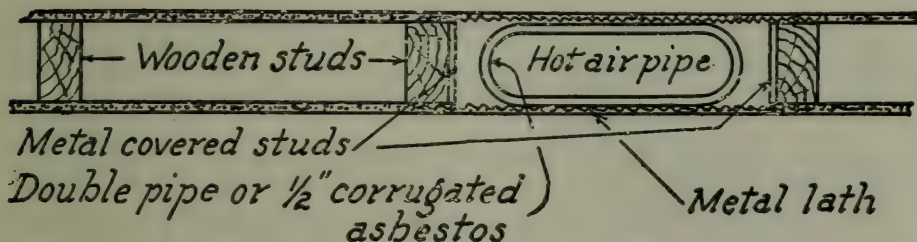


FIG. 32.

Protection of hot air pipe in wooden stud partition.

3. Cold air ducts for hot air furnaces shall be made of incombustible material.

4. Hot air pipes, where passing through combustible partitions or floors, shall be doubled tin pipes with at least 1 inch air space between them.

No hot air pipe shall be placed in a wooden stud partition or any wooden enclosure unless it be at least 5 feet horizontal distance from the furnace. Hot air pipes contained in combustible partitions shall be placed inside another pipe arranged to maintain $\frac{1}{2}$ inch air space between the two on all sides, or be securely covered with $\frac{1}{2}$ inch of corrugated asbestos. Neither the outer pipe nor

the covering shall be within 1 inch of wooden studding, and no wooden lath shall be used to cover the portion of the partition in which the hot air pipe is located, Fig. 32. Hot air pipes in closets shall be double, with a space of at least 1 inch between them on all sides. The air space between pipes shall be open at bottom and closed at top.

5. Every hot air furnace shall have at least one register without valve or louvres.

6. A register located over a brick furnace shall be supported by a brick shaft built up from the cover of the hot-air chamber; said shaft shall be lined with a metal pipe, and no woodwork shall be within 2 inches of the outer face of the shaft.

A register box placed in the floor over a portable furnace shall have an open space around it of not less than 4 inches on all sides, and be supported by an incombustible border.

Hot air registers placed in any woodwork or combustible floors shall be surrounded with borders of incombustible material, not less than 2 inches wide, securely set in place.

The register boxes shall be of metal, and be double; the distance between the two shall be not less than 1 inch; or they may be single, if covered with asbestos not less than $\frac{1}{8}$ inch in thickness, and if all woodwork within 2 inches be covered with metal.

Section 183. Steam and Hot Water Pipes. No steam or hot water pipe shall be within 1 inch of any woodwork. Every steam or hot water pipe passing through combustible floors, or ceilings, or wooden lath and plaster partitions, shall be protected by a metal tube 1 inch larger in diameter than the pipe and be provided with a close-fitting metal cap on each side of the floor or partition. Fig. 33. All wooden boxes, or casings enclosing steam or hot water heating pipes, or wooden covers to recesses in walls in which steam or hot water heating pipes are placed, shall be lined with metal, and the pipes shall be kept at least 1 inch away from the walls of the box. Steam and hot water pipe coverings shall be of incombustible material.

NOTE.—Where waterproof floors are provided, it is important that metal sleeves which encase shafts or steam pipes should extend at least 6 inches above the floor level and be capped as above required. This provides a dam to prevent water flowing to floors below if from any cause the floor should become flooded.

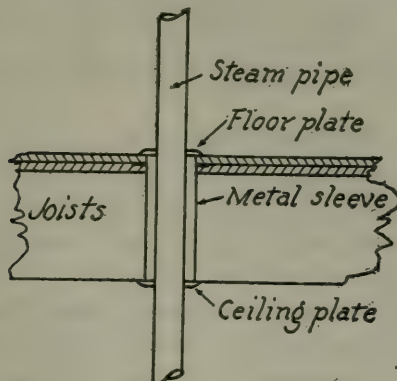


FIG. 33.

Protection of pipe or shaft openings through floors.

Section 184. Vent Flues and Ducts.

1. Vent flues or ducts for the removal of foul air, which the temperature of the air cannot exceed that of the room, may in non-fireproof buildings be constructed of sheet metal or other incombustible material. When used in connection with an exhaust fan, such duct shall not be placed nearer than 1 inch to any woodwork. All such ducts shall open to the outside of the buildings.

2. All openings into such vents or ducts shall be protected by automatic or self-closing fire doors, or by automatic closing metal louvres or dampers.

3. Vent flues and ducts connected with hoods over restaurant ranges shall be constructed in accordance with the requirements for smoke flues, Section 178, and for smoke pipes, Section 179, and shall be used for no other purpose.

4. All ducts from blower heating and ventilating systems which pass through stories shall be made of or protected throughout by approved fire-resisting material not less than 3 inches thick if of brick, block, or tile; or $2\frac{1}{2}$ inches of solid metal lath and cement plaster. Where such

ducts serve more than one story, automatic dampers shall be provided on all outlets opening directly from such ducts and at all connections with branch ducts.

NOTE.—For construction details of forced draft ventilating systems, see "Regulations of the National Board of Fire Underwriters governing Blower Systems for Heating and Ventilating, Stock and Refuse Conveying."

Vent shafts in fireproof buildings, Sec. 90-92.

Section 185. Dry Rooms.

No combustible materials shall be permitted in the construction of any dry room in which a temperature of 125 degrees F. or over may exist. If a temperature under 125 degrees F. is to be used, the dry room may be constructed of wood, but shall be lined throughout with $\frac{1}{8}$ inch asbestos or $\frac{1}{2}$ inch plaster board and covered with sheet metal; or the covering may consist of metal lath or plaster board, plastered to a total thickness of at least $\frac{3}{4}$ inch. Cement plaster or cement-tempered plaster shall be used.

PART XXVII.

EXISTING BUILDINGS RAISED, ALTERED, REPAIRED OR MOVED.

Section 186. Buildings Raised, Altered, Repaired or Moved.

1. Within the fire limits every existing building having a combustible roof, if raised to produce an additional story, shall be provided with an incombustible roof.

2. No building within the fire limits having masonry walls shall be enlarged or built upon unless the addition to the exterior walls be of approved incombustible materials.

3. No existing building shall be altered to exceed the limits of height or area provided by this Code for new buildings of the same class as that to which the additions are made.

4. No existing frame building shall be raised to a height exceeding 30 feet, except that dwellings occupied by not more than one family may be raised to 35 feet. Buildings so raised shall comply with paragraph 1 and all the requirements of this Code relating to frame buildings.

5. Within the fire limits no frame building more than two stories in height shall be altered to be used as a factory, warehouse or stable.

6. No frame building within the fire limits shall be increased in area by frame additions, except that frame extensions to be used exclusively for toilet purposes may be permitted, but any such extension shall have an approved roof covering.

7. Any frame building which may hereafter have the first story converted into a store shall have the walls, partitions and ceiling of such first story covered with metal lath or $\frac{1}{2}$ inch fibre plaster board and plastered to a total thickness of at least $\frac{3}{4}$ inch; or the plaster board may be covered with sheet metal. Fire stops shall also be provided at the line of the ceiling to cut off all connection to stories above through hollow stud partitions or side walls.

Fire stops in frame buildings, Sec. 190, par. 5.

8. Any existing frame building within the fire limits, which may hereafter be damaged by fire, decay or otherwise to an amount greater than one-half of its value exclusive of the foundation, shall not be repaired or rebuilt, but shall be immediately removed.

In case the owner of the damaged building shall be dissatisfied with the decision of the Superintendent that such building is damaged to a greater extent than one-half of its value exclusive of the foundation, the amount and extent of such damage shall be determined upon an examination of the building by three competent persons, one of whom shall be appointed by the Superintendent, another shall be appointed by the owner of the building and the third shall be appointed by the..... Board of Fire Underwriters; a decision of a majority of these surveyors reduced to writing and sworn to shall be conclusive, and such building shall in no manner be repaired or rebuilt until after such decision shall have been rendered.

9. No frame building shall be moved from without to within the fire limits.

10. No building shall be moved until a permit has been obtained from the Superintendent, and he shall not issue

such permit if in his judgment the proposed new location of the building would seriously increase the fire hazard of the surrounding buildings.

PART XXVIII. FRAME BUILDINGS.

Section 187. Permissible Wooden Buildings or Structures Within Fire Limits. No frame building or structure shall be erected within the fire limits except the following; and all roofs placed upon such buildings or structures shall have approved covering:

- (a) Temporary one story frame buildings for use of builders, and temporary stands, platforms, booths and tents, for which permits shall be obtained from the Superintendent. Such frame structures for use of builders in connection with the erection of a new building shall be removed as soon as the building is completed; other temporary frame structures shall be removed as soon as they have ceased to serve the original purpose for which they were permitted;
- (b) One story sheds open on the long side, not over 15 feet high, with sides covered with incombustible material, and with an area not exceeding 500 square feet. A wooden fence shall not be used to form the back or side of such sheds;
- (c) Wooden fences not over 10 feet high;
- (d) Piazzas or balconies not exceeding 10 feet in width, nor extending more than 3 feet above the second-story floor beams. No such structure shall extend beyond the lot line, or be joined to any similar structure of another building;
- (e) Bay windows when covered with incombustible material, and as limited by Section 101, paragraph 4.
- (f) Small outhouses not exceeding 150 square feet in area and 8 feet in height;
- (g) Ice houses not exceeding 15 feet in height nor more than 300 square feet in area. Wooden sheds, ice houses, or outhouses shall not be located within 5 feet of any lot line, nor less than 30 feet from any other building over one story high.
- (h) Signs as provided by Section 263.

Section 188. Frame Buildings Outside of Fire Limits.

1. No frame building shall exceed two stories or 30 feet in height, except that dwellings may have two and one-half stories, provided they do not exceed 30 feet in height or 3000 square feet in area. The attic in a two-and-a-half story house may be used for sleeping rooms, but not for living purposes. No family shall be domiciled above the second story. Dwellings occupied by not more than one family may be three stories or 35 feet high. Towers, turrets or minarets on such buildings may exceed the foregoing limit 10 feet, provided the greatest horizontal dimension of such structures does not exceed 15 feet; except also that a church spire may be constructed of wood to a height not exceeding 75 feet from the ground, but such spire shall not be placed nearer any other building or structure than the equivalent of its height measured from its masonry support to the pinnacle.

2. All frame buildings or structures shall have approved roof coverings as specified in Section 80.

Buildings classed as frame, Sec. 10, par. 2.

3. No frame building, erected for any occupancy other than buildings of Class F, shall cover a ground area exceeding 5000 square feet, except as restricted in paragraph 4; except also that a frame building equipped with an approved system of automatic sprinklers may have an increase in area of $66\frac{2}{3}$ per cent, or 8333 square feet.

Frame tenements, Sec. 301.

4. Frame buildings of Class F, and frame buildings of other classes having an area exceeding 5000 square feet without sprinklers, shall not be placed within 35 feet of any side or rear lot line; and if the area exceeds 7500 square feet, the distance from a side or rear lot line shall be not less than 100 feet.

5. The combined area of frame buildings, sheds and outhouses located on any lot shall not exceed 80 per cent. of the lot area.

6. In no case shall a frame building with wooden siding be erected or altered, to extend within 5 feet of the side or rear lot line, nor within 10 feet of another building on the same lot, unless the space between the studs on such side be

filled solidly with not less than $2\frac{1}{2}$ inches of brickwork or other equivalent incombustible material, and the entire exposed side be covered with at least a $\frac{1}{8}$ inch layer of asbestos board, or $\frac{3}{8}$ inch of plaster board back of the wooden siding. When such walls are thus filled and covered, their distance from a side or rear lot line may be reduced to 3 feet; or to 5 feet from another building on the same lot. If the adjacent walls of two buildings have no openings, and are filled and covered as above specified, there need be no limitation as to distance between them.

NOTE.—It is recommended that when such buildings are nearer than 3 feet to a side or rear lot line, or 5 feet to another building, the cornices and overhanging eaves on the side or rear walls shall be of, or covered with, incombustible material. See Note in Section 85.

Alterations in existing frame buildings, Sec. 186.

7. Floor beams and rafters in frame buildings shall be not less than 2 inches (mill size) in thickness. All frame or wood buildings exceeding 15 feet in height shall have their sills secured to the foundations in an approved manner and be erected with sills, posts, girts and plates of suitable size and materials with proper mortise and tenon framing and braced with studs at all angles, but this shall not prohibit the use of balloon framing with proper sills and ribbon strip not less than $1\frac{1}{4}$ by 5 inches where diagonal sheathing is used, and provided that the outside walls are fire stopped at each floor level as required by Section 190, paragraph 5.

Quality of timber, Sec. 61.

Timber stresses, Sec. 65.

Safe loads for beams of varying size and span. Appendix, pages 286 to 292.

Section 189. Foundations for Frame Buildings.

1. The foundation walls of frame buildings or structures exceeding 15 feet in height shall rest on footings of stone or concrete not less than 8 inches in vertical thickness. All footings shall extend at least $4\frac{1}{2}$ inches outward from each side of the bottom of the foundation walls which rest upon them.

2. The bottom of footings for frame buildings shall rest upon solid ground at a depth at least equal to the frost line below the surface, unless solid rock occurs above this

point; or upon piles or ranging timbers of wood where necessary. The foundation walls of frame structures exceeding 15 feet in height, if of stone, shall be not less than 16 inches thick, and if of brick or concrete, not less than 12 inches to the grade and 8 inches thick to the under side of the sill. If the foundation and first story walls are constructed of brick or concrete, the foundation walls shall be not less than 12 inches thick to the first tier of beams and 8 inches thick from the first to the second tier of beams, or if these walls are constructed of stone, they shall be not less than 18 inches for the foundation walls and 16 inches for the first story wall.

Piles under frame building, Sec. 19, par. 6.

3. Foundation walls of hollow building blocks shall be not less than 12 inches thick in any part, and shall be constructed as specified in Section 17, paragraph 4.

4. For one story structures not used for dwellings, the thickness and depth of the foundation walls may be modified at the discretion of the Superintendent.

5. Footings and foundation walls shall be laid in cement mortar.

Section 190. Walls and Partitions in Frame Buildings.

1. In rows of frame houses and in double frame houses the dividing walls or partitions between houses shall be built of brick, terra cotta, concrete, or other approved incombustible material; or they may be built with 4 inch studs, filled solidly with brickwork laid in mortar, or with other incombustible material and covered on each side with at least $\frac{1}{2}$ inch of metal lath and plaster, or plaster board. Such dividing partitions shall rest on masonry walls or wooden girders and shall extend to under side of roof boards, and a flush mortar joint shall be made between the roof boards and the wall or partition. In rows of more than three houses, every alternate division wall or partition shall be constructed of brick, concrete or hollow tile not less than 8 inches thick. These walls shall extend from front to rear, be solid without openings, and shall extend at least 2 feet above the roof, and be coped. If such parapet be of concrete, or if the top six courses of brick be laid in portland cement the coping may be omitted.

Fire walls in frame buildings, Sec. 29.

2. The ends of floor beams entering such walls from opposite sides shall be so staggered or separated that there shall be not less than 4 inches of masonry between the beams where they rest on the walls.

3. Timber posts and girders or other approved supports may be used instead of brick fore and aft partitions, in cellars of frame buildings.

4. All stairway and other interior shafts in frame buildings which are required to be enclosed, including dumbwaiter shafts, may be constructed of wood, but they shall be covered with metal lath, or fibre plaster board at least $\frac{1}{2}$ inch thick, and plastered to a total thickness of $\frac{3}{4}$ inch; or the plaster board may be covered with sheet metal. Doors opening into such shafts shall be incombustible.

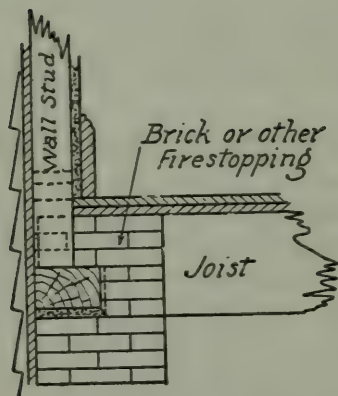


FIG. 34.

Fire-stopping of floor in frame building supported on foundation wall.

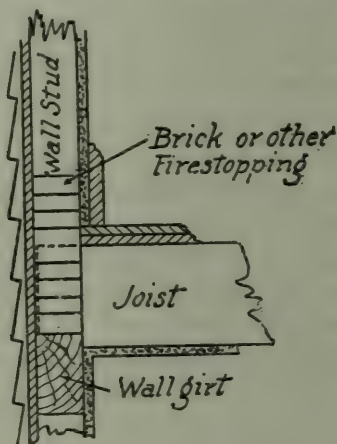


FIG. 35.

Fire-stopping of floor in frame building supported by timber wall girt.

5. In all frame buildings which are to be lathed and plastered or otherwise sheathed on the inside, all stud walls and all partitions which rest directly over each other shall be completely fire-stopped with brickwork or other suitable incombustible material at each floor level. The spaces between the ends of floor joists which rest upon masonry foundation walls or upon wall girts shall be filled solidly with fire-stopping material to the full depth of the joists, and the spaces between the studs shall be filled in the same manner

to a height of 4 inches above the floor level. See Figs. 34 and 35. Partitions which rest over each other shall be fire-stopped as required in Section 97, paragraph 3. The fire-stopping shall be arranged to cut off all concealed draft openings, and form an effectual horizontal fire barrier between stories.

Section 191. Cellar Ceiling in Frame Buildings. The ceiling over the cellar or lowest floor in every frame building more than one story in height, except dwellings, shall be covered with metal lath and at least a $\frac{3}{4}$ inch coat of cement or cement-tempered plaster; or by a $\frac{1}{2}$ inch layer of plaster board covered with a $\frac{1}{4}$ inch coat of plaster or with a layer of sheet metal.

Cellar ceilings in non-fireproof buildings, Sec. 99, par. 5. •

Cellar ceilings in non-fireproof tenements, Sec. 271, par. 3.

Section 192. Chimneys. All chimneys in frame buildings shall conform to the requirements for chimneys in Section 178.

PART XXIX.

STANDPIPE REQUIREMENTS.

Section 193. Standpipes for Fire Department Use.

1. In existing buildings not already provided with a 4 inch or larger standpipe, and in buildings hereafter erected, there shall be provided:

For buildings in excess of 4 stories or 55 feet in height and not within 75 feet of exposing buildings, a standpipe not less than 4 inches in diameter;

For other buildings in excess of four stories or 55 feet in height, a standpipe not less than 5 inches in diameter;

For buildings in excess of six stories or 75 feet in height, a standpipe not less than 6 inches in diameter.

2. Standpipes shall be located within fireproof stairway inclosures. Provided that, where existing buildings do not have such inclosures, the standpipes shall be as near stairway as possible, or shall be on the outside of, embedded

within or immediately inside an exterior wall and within 1 foot of a fire escape, fire tower, or outside exit stairway.

3. One standpipe shall be provided for each separate fire area exceeding 2500 square feet area, with at least one standpipe within 75 feet of every exterior wall in the building.

4. Where more than one standpipe is required in a building they shall be connected at their bases by pipes of size equal to that of the largest standpipe, so that water from any source will supply all the standpipes.

5. Standpipes shall extend from the cellar to and through the roof, with a 2½-inch hose connection and gate valve not over 5 feet above floor level in each story, including cellar, and two 2½-inch hose connections, with gate valve for each, on the roof; roof connections to have a controlling gate valve under the roof and arranged to be operated both from above and below the roof, with ¾-inch drain pipe and valve to prevent freezing.

6. Where standpipes are located inside of building, hose sufficient to reach to all parts of the fire section, but not in excess of 100 feet, shall be attached to each outlet, with hose for roof-hydrant either in hose house on roof or on rack in top story near roof scuttle. Hose shall be not less than 2½ inches in diameter, and provided with standard couplings in use by the local fire department.

7. Hose to be approved linen in 50-foot lengths, made under specifications recommended by the National Board of Fire Underwriters.

8. Each line of hose shall be provided with washers at both ends, and be fitted with smooth-bore brass play pipe or nozzle at least 12 inches long, with discharge outlet 1⅛ inches in diameter. One spanner to be located at each hose connection.

9. Standpipes shall be wrought iron or steel, galvanized, and, together with fittings and connections, shall be of such strength as to safely withstand at least 300 pounds water pressure to the square inch when ready for service, without leaking at joints, valves or fittings; such test to be made by the Chief of the Fire Department.

10. Standpipes shall be connected to a Siamese steamer connection outside of the building by a pipe of diameter equal to that of the largest standpipe supplied. Such connection shall be made on each street front, except that corner buildings having one street frontage of less than 50 feet may have only one connection. Siamese shall be about one foot above the curb level, and shall be provided with check valves, and substantial caps to protect thread on the connection; the thread shall be uniform with that used by the local fire department. A suitable iron plate with raised letters shall be provided, reading: "To Standpipe."

Just inside of the building, in a horizontal section, shall be placed a straight-way check valve. A drip pipe, with valve to same, shall be placed between said check valve and Siamese connection to properly drain this section to prevent freezing.

11. Fire pumps, permanently connected to the stand pipe system, shall be provided for buildings eight stories or more in height and in any building in excess of 10,000 square feet area, with capacities as follows:

One 4- or 5-inch standpipe, pump capacity not less than 500 gallons a minute;

One 6-inch standpipe or two inter-connected 5-inch standpipes, pump capacity not less than 750 gallons a minute;

Two 6-inch standpipes, pump capacity not less than 1000 gallons a minute.

Pump to have an adequate source of power and be supplied from street main or from well or cistern containing at least one hour's full supply; suction piping to be well installed.

Section 194. Standpipes for Private Protection.

1. In existing and new buildings three stories and higher, except as given below, there shall be provided a standpipe not less than 2 inches in diameter, with water supply constantly maintained or furnished automatically with the opening of a hose valve.

Exceptions: Buildings equipped with inside standpipe for fire department use (see Section 193) and having also 1½-inch connections with hose attached, and automatic water supply, all as provided in paragraphs 2, 3 and 4 of this section;

Dwellings;

Churches;

Other buildings having maximum undivided fire section of less than 2500 square feet area and provided with at least one 2½-gallon approved chemical extinguisher to each fire section;

Sprinklered buildings where the requirements of this section are met by connecting hose to sprinkler riser.

2. Supply shall be from one of the following sources:

Street main, where pressure is sufficient to maintain not less than 25 pounds at hose outlet in top story;

Gravity tank of 2500 gallons capacity, with bottom 25 feet above outlet in top story;

Pressure tank of 3750 gallons capacity, located in top story or on roof;

Automatic pump of at least 250 gallons a minute capacity.

Provided that, if standpipe is intended also for fire department use (see Section 193), tank or pump capacity shall be at least double that given above.

3. Where a standpipe is connected to fire pump or provided with Siamese connection, a straight-way check valve shall be provided in connecting pipe to tank, and tank filled by a separate pipe; and where the water in such tank is also used for house supply, the house supply pipe shall extend above the bottom of the tank to such a height as will reserve for fire purposes not less than the quantities required in paragraph 2.

4. Standpipes shall extend from the cellar to the roof, with a 1½-inch hose connection and gate valve not over 5 feet above floor level, in each story, including cellar and roof.

Hose sufficient to reach to all parts of the fire section, but not in excess of 100 feet, shall be attached to each outlet; hose for roof outlet may be placed on rack in top floor near the scuttle leading to the roof. Hose shall be 1½ inches in diameter, and provided with nozzle having ½-inch discharge outlet.

5. Standpipes and hose shall comply with the requirements of Section 193, Paragraphs 3, 4, 7 and 9, except that 150 pounds test pressure will be required.

PART XXX.

SPRINKLER REQUIREMENTS.

Section 195. Sprinklers.

1. In all new or existing buildings, an approved automatic sprinkler system, so constructed as to protect every square foot of floor area, shall be provided as follows:

- (a) In every cellar, basement or sub-basement, including spaces under sidewalks, used for the manufacture, sale or storage of combustible goods or merchandise.

Exceptions: Class A, B, C and D buildings and office buildings, except such portions of cellars, basements and sub-basements as are used for storage purposes or as workshops.

All buildings outside the fire limits and with basement section of less than 2500 square feet area.

Classification of buildings, Sec. 11.

- (b) Throughout all buildings having maximum fire area in excess of those permitted in Section 38.
- (c) Throughout all buildings of Class E and F, where the height exceeds 5 stories, except that in office buildings such system shall be required only in sample, shipping, storage or stock rooms which exceed 1000 square feet area and contain combustible goods or supplies not stored in enclosed fire-resisting shelving.
- (d) Throughout Class E and F buildings over 2 stories high, used for the manufacture, sale or storage of combustible goods or merchandise, if within 50 feet of other buildings having wall openings not protected as given in Section 88, or if in non-fireproof buildings

- (e) Over all heating furnaces or boilers in Class A, B, C and D buildings unless in fireproof rooms, except dwellings.

NOTE.—It is the intent of the above requirements to provide sprinkler equipments in buildings or parts of buildings where conditions likely to originate fire exist, and in all buildings of excessive height or area. It must be recognized that automatic sprinkler equipments not only lessen the danger of serious spreading fires, but are the greatest safeguard known in reducing the life hazard in occupancies requiring a congestion of people in conjunction with readily inflammable material.

Sprinkler requirements in theatres, Sec. 252.

Sprinklers in communicating stores, etc., Sec. 29, par. 3.

2. Sprinkler heads shall be a kind approved by the Underwriters' Laboratories, Inc., of Chicago, or by the Associated Factory Mutual Laboratories, of Boston.

3. Sprinkler heads shall be so placed as to thoroughly protect all parts of the area in which they are installed, including spaces under stairs, inside elevator wells, in belt, cable, pipe, gear and pulley boxes, inside small enclosures, such as drying and heating boxes, tenter and dry room enclosures, chutes, conveyor trunks, and all cupboards and closets unless they have tops entirely open and are so located that sprinklers can properly spray therein. Each sprinkler head to protect not in excess of 100 square feet area.

4. The size of riser serving any one floor of one fire area shall not be less than the following, and the number of sprinklers on a given size pipe on one floor of one fire area shall not exceed the following:

Size of Pipe	Maximum No. of Sprinklers Allowed.
¾-inch.....	1 sprinkler
1 ".....	2 sprinklers
1¼ ".....	3 "
1½ ".....	5 "
2 ".....	10 "
2½ ".....	20 "
3 ".....	36 "
3½ ".....	55 "
4 ".....	80 "
5 ".....	140 "
6 ".....	200 "

5. Each system shall be provided with an outside screw and yoke gate valve so located as to be readily accessible and to control all sources of water supply, except that from steamer connections. Drain pipes shall be provided, and the system so installed as to drain all parts.

6. A dry pipe system shall be used only when a wet pipe system is impracticable, as in buildings which have no heating facilities.

7. Two independent water supplies shall be provided, at least one of which shall be automatic. Provided that, where sprinklers are required only in cellars, basements, and first stories, a connection to street main will be deemed sufficient.

NOTE.—Supply from street mains is not sufficient for automatic supply unless giving, in highest line of sprinklers, at least 25 pounds static pressure, and able to maintain 10 pounds pressure with the water flowing through the number of sprinklers judged liable to be opened by fire at any one time.

8. Pressure tanks, if used, shall have a total capacity of not less than 4500 gallons (3000 gallons of water), and in any event the tank or tanks shall contain sufficient water to supply 12½ per cent. of the greatest number of sprinklers within a fire area on any one floor for 20 minutes with an average discharge of 20 gallons per minute per sprinkler.

9. Gravity tanks, if used, shall contain an available quantity of water sufficient to supply 25 per cent. of the greatest number of sprinklers in a fire area on any floor to which it gives protection, for 20 minutes with an average discharge per sprinkler of 20 gallons per minute, but tank shall be not less than 5000 gallons available capacity.

Elevation of bottom of tank above the highest line of sprinklers on the system which it supplies shall be not less than 20 feet.

Requirements for tanks, Sec. 84.

10. Fire pumps, if used, shall be of not less than 500 gallons capacity per minute, and sufficient to supply 50 per cent. of the number of sprinklers within a fire area on any floor with an average discharge per sprinkler of 20 gallons a minute. Pump to have an adequate source of power and be supplied from street main or from well

or cistern containing one hour's full supply for the number of sprinklers judged liable to be opened by fire at any one time; suction piping to be well installed.

11. The system shall be connected to a Siamese steamer connection outside of the building by a pipe of diameter equal to that of the largest standpipe supplied. Such connection shall be made on each street front, except that corner buildings having one street frontage of less than 50 feet may have only one connection. Siamese shall be about one foot above the curb level, and shall be provided with check valves, and substantial caps to protect thread on the connection; the thread shall be uniform with that used by the local fire department. A suitable iron plate with raised letters shall be provided, reading: "To Basement Sprinkler" or "To Cellar Sprinkler," where only these are installed, or "To Automatic Sprinkler" where entire building is equipped.

12. Just inside of the building, in a horizontal section, shall be placed a straightway check valve. A drip pipe, with valve to same, shall be placed between said check valve and Siamese connection to properly drain this section to prevent freezing.

13. Piping shall be wrought iron or steel, galvanized, and, together with fittings and connections, shall be of such strength as to safely withstand at least 150 pounds water pressure to the square inch for 2 hours when ready for service, without leaking at joints, valves, or fittings; such test to be made by the Chief of the Fire Department.

14. All such sprinkler equipments shall be in accordance with the regulations of, and plans shall meet the approval of, the Chief of the Fire Department.

NOTE 1.—For complete details of sprinkler systems see the "Regulations of the National Board of Fire Underwriters Governing the Installation of Sprinkler Equipments."

NOTE 2.—It is generally recognized among fire-protection engineers that the introduction of an approved system of automatic sprinklers in a factory where the conditions of manufacture constitute a fire hazard, not only furnishes excellent security against loss by fire, but that it soon pays for itself by the reduction in insurance premiums. The period necessary for this reimbursement usually varies from four to seven years depending upon the condition surrounding the risk. The automatic sprinkler installation is therefore an excellent financial investment aside from the protection it affords to life and property against fire.

PART XXXI.

CONSTRUCTION AND EQUIPMENT OF THEATRES.

Section 196. Buildings Covered. Every theatre or opera house or other building or parts of building designed or used for theatrical or operatic purposes, or motion picture shows, for the accommodation of a total of more than 300 persons on all tiers, shall be built to comply with the requirements of this Code.

Definition of theatre, Sec. 7, par. 65.

Section 197. Capacity. The Superintendent shall determine the number of persons which every such building may accommodate. This determination shall be based on the actual number of seats and an allowance of 3 square feet per person for all parts of the auditorium or galleries where "standing room" may be provided. By standing room is meant such space in which by law persons may be permitted to stand during any performance. Such measurements are to be exclusive of required aisles, passageways and lobbies. No more than the number so determined and certified by the Superintendent shall be allowed in such structure at any one time.

Section 198. Alterations. No building which at the time of the passage of this Code is not in actual use for the purposes indicated in Section 196 shall be altered or added to for the purpose of converting the same into a theatre, opera house, or for use by a motion picture show, unless when altered or added to, it conforms to the requirements of this Code.

Section 199. Approvals Required. No building described in Section 196 shall be opened to the public until the Superintendent shall have approved the same in writing in conformity with Section 8 of this Code, nor until the Chief of the Fire Department shall have certified in writing that all appliances for the extinguishing of fire conform to the requirements of Section 254 of this Code, and to the special requirements of the Fire Department, and are in a complete and satisfactory working condition.

Section 200. Fireproof Building Over Auditorium.

Nothing herein contained shall prevent the construction of a thoroughly fireproof building above a fireproof theatre, providing no part of such fireproof building shall be placed above that portion of any such building which is known as the stage section. The portion containing the theatre, including all passages, lobbies and other accessories connecting therewith, shall be cut off vertically from such fireproof building by unpierced fire walls of solid masonry not less than 12 inches thick, and horizontally by unpierced fireproof floors of strength to safely sustain a live load of 150 lbs. per sq. ft. on every superficial foot.

Section 201. Roof Garden.

1. A roof garden or open air auditorium (but no other place of public amusement) may be constructed above a fireproof building used for theatrical purposes built in conformity with the requirements of this Code. Such roof garden or open air auditorium shall have not less than 60 per cent. of its total floor area open to the sky without a roof, except that a cover of glass and metal skylight construction may be provided, and no part of its seating floor, or space upon which seats might be placed, shall be at greater height than 90 feet above the curb level at the main entrance to the building. The total capacity of such roof garden or open air auditorium shall not exceed 750 persons, figured on the same basis as that provided in Section 197. The construction of such roof garden or open air auditorium shall be fireproof and shall conform in every way to the requirements of this Code.

2. The size of entrances and exits, corridors and stairways shall be 50 per cent. greater than the corresponding requirements for theatres where the orchestra floor is at or about the street level. If an audience is to be assembled in the theatre, at the same time as in the open air auditorium or roof garden constructed above the same, then the provisions for such entrance and exit herewith required for the latter shall be entirely distinct from and in addition to the provisions for exits and entrances, corridors and stairways required for the structure below.

3. If any structure is built over the ceiling or roof of any building used for a theatre, the girders, trusses or other

metal members supporting said structure shall be protected against fire by at least 3 inches of fireproof material with special provision to reinforce or support it.

Section 202. Occupancy Restricted.

1. No portion of any building erected or altered, used or intended to be used for a theatre, shall be occupied or used for any business dealing in any article or material dangerous to life in the opinion of the Superintendent.

2. The before-mentioned restrictions relate not only to that portion of the building which contains the auditorium and the stage, but apply also to the entire structure in conjunction therewith.

Section 203. Workshops and Property Storerooms.

1. No workshop, storage or general property room shall be allowed in or under the auditorium, above the stage or under the same, or in any of the fly galleries; but such rooms or shops may be located in the rear of, or at the side of the stage, and in such cases they shall be separated from the stage vertically and horizontally by a brick or concrete wall not less than 12 inches in thickness or other equally efficient cut-off, and the openings leading into said portion shall have self-closing fire doors on one side of the wall and automatic fire doors on the other side of the wall.

2. No sleeping accommodations shall be allowed in any part of the building communicating with the auditorium or stage.

Section 204. Separation of Vestibule from Auditorium. Interior fireproof walls or partitions shall separate the auditorium from the entrance vestibule, and from any communicating room or rooms over or under the same, also from any lobbies, corridors, refreshment or other rooms forming part of the theatre; the openings in all such walls shall be protected by approved fire doors or fire windows. The doors shall be self-closing, and the windows shall be stationary.

Section 205. Floors. All floor surfaces shall be of concrete or other incombustible material, and no wooden boards or sleepers shall be used as a covering for floors, seat platforms, aisles, steps, landings, passages or stairs.

Section 206. Trim. No combustible doors or trim shall be used in the auditorium, and none of the walls or ceiling shall be covered with wooden sheathing, wainscoting, or other combustible material, but this shall not preclude the construction of a wooden sounding board over orchestra pit when the same extends back of and below the overhang of the stage, provided the said wooden sheathing be properly fire stopped by a 12-inch brick wall back of same, and also have a proper fireproof construction directly under the overhang of the stage extending from the brick wall to the apron of stage.

Section 207. Seats.

1. All seats in the auditorium except those contained in boxes accommodating not more than 12 persons shall be firmly secured to the floor, and shall be placed not less than 32 inches from back to back, measured horizontally. If benches without arms between seats are used, their capacity shall be figured on the basis of one person to each 18 inches in width.

2. No seat in any gallery shall have more than four seats intervening between it and an aisle, or more than ten seats in a row between any two aisles.

Section 208. Gallery Platforms. No platforms in galleries formed to receive the seats shall be more than 21 inches in height of riser nor less than 32 inches in width of platform. No such platform shall be nearer than 8 feet from the ceiling.

Section 209. Tunnels or Cross Aisles. There shall be no more than 11 feet rise, measured vertically, in any aisle in any gallery without direct exit by tunnel or otherwise to a corridor or passage with a free opening to the gallery stairs or other direct discharge to the street. At such elevation of 11 feet or less, an intervening or cross aisle leading directly to an exit may be substituted for the tunnel. No such tunnel or cross aisle shall be less than 4 feet wide in the clear.

Section 210. Aisles—Width of. Aisles shall be not less than 3 feet wide at the beginning, and all aisles shall be increased in width toward the exits 3 inches for every 10 feet of length.

Section 211. Steps in Aisles. Steps in aisles shall be the full width of the aisle. No risers shall be more than 9 inches in height, and no tread shall be less than 10 inches in width, and whenever the rise of seat platforms is 4 inches or less, the floor of the aisles shall be made as a gradient. Where steps are placed in passages they shall be grouped together and shall be clearly lighted. No stool, seat, or other obstruction shall be placed in any aisle.

Section 212. Floors at Exits. In the auditorium there shall be no step within 4 feet of the front of an exit or entrance doorway, nor within one foot of the side thereof.

Section 213. Passages.

1. The width of passages and hallways shall be computed in the same manner as that hereinafter provided for stairways, but no passage may be less than 5 feet in width.

2. All passages, hallways, and stairways leading from any balcony or gallery in any direction shall permit of free passage to an exit, without returning.

3. The aggregate capacity of the foyers, lobbies, hallways, passages, and rooms for the use of the audience, not including aisle space, shall on each tier be sufficient to contain the entire number to be accommodated on said tier, in the ratio of 150 superficial square feet of floor for every hundred persons.

Section 214. Calculation of Exits.

1. The combined width of entrances and exits for each tier, likewise their stairways, shall provide one foot of width for each 20 persons to be accommodated in that tier.

NOTE.—The following explanation may be of interest with relation to entrance and exit calculations:

A large number of actual counts made by reliable authorities (see paper entitled "A Terminal Station," presented by Messrs. J. Vipond Davies and J. Hollis Wells before the American Institute of Architects at Washington, D. C., December, 1909) show that with freely moving crowds going in one direction, an average of thirteen (13) people per foot of width per minute will pass down a stairway. This figure was accordingly selected as a basis for estimating the combined width of entrance and exit stairs, allowing a period of 2 minutes in which to empty each tier.

Considering the probability of unfavorable conditions due to a panic or other causes, the width of entrance and exit stairs is figured on the assumption that two-thirds of the audience may pass out at either side of the auditorium.

The calculation under the above conditions for determining the necessary total width for entrance and exit stairways, for any specified number of people such as 500, would have this form:

$$\frac{2/3 \times 500}{2 \times 13} \times 2, \text{ or in reduced form } 500 \div 19.5$$

For further simplification, the derived number is assumed as 20 instead of the actual 19.5. This will give stairs but slightly narrower than those which would be obtained by applying the formula in detail, and makes the calculation extremely simple.

It is further specified that the width of the entrance stairways shall be at least 50 per cent. of the total stairway capacity provided by this calculation.

To encourage the audience to divide and thus offset in part at least the instinctive tendency to escape by way of the most familiar entrance, the aggregate width of exit doorways opening from each gallery shall be at least 60 per cent. wider than the exit stairways to which they lead; persons after reaching the exit stairways and balconies are comparatively safe when they have passed beyond the exit doorways opening from any tier under consideration.

Attention is also called to the *minimum* requirements for both stairways and doorways which must always obtain.

2. The width of entrance stairways shall be at least 50 per cent. of the combined width of the entrance and exit stairways, and the aggregate width of emergency exit doorways opening from each gallery shall be 60 per cent. more than the stairways to which they lead.

Section 215. Entrances.

1. A common place of entrance may serve for the orchestra floor of the auditorium and the first gallery, provided such entrance and the passages leading thereto are of the width required for the aggregate capacity of these two tiers.

2. Separate places of entrance shall be provided for each gallery above the first.

3. Where the number accommodated in a gallery exceeds two hundred, there shall be at least two separate and distinct entrances.

Section 216. Entrances on Street Fronts.

1. Every building used for the purposes designated in Section 196 shall have at least the front or one side wall

bordering on a street, and not less than one-half of the openings required for entrance of the audience to the auditorium shall be provided in such wall or walls.

2. Entrances opening directly on a street shall not be on a higher level from the sidewalk than four steps of $7\frac{3}{4}$ inch rise.

3. Where any entrance does not open directly on a street, corridor, or passage connecting with the street, it shall be constructed of continuous walls of brick or other fireproof material equally efficient. The roof construction of these corridors shall be fireproof and of strength sufficient to safely sustain a live load of 150 pounds per square foot of area. The height of such corridors shall be not less than 10 feet. No doors or windows shall be permitted in the side walls or roof.

Section 217. Emergency Exits. From the auditorium at least two emergency exits remote from each other leading into open courts or streets shall be provided in each side wall of the auditorium on all tiers. Each exit shall be provided with approved fire doors.

Entrances in courts, Sec. 233.

Section 218. Entrance and Exit Doorways.

1. The minimum width of doorways shall be 5 feet in the clear, except emergency exit doorways, which may be 44 inches.

2. All entrance and exit doors shall open outward, and be hung in such manner as not to obstruct any part of the required width of a doorway, passage or stairway. The fastenings of these doors shall be such as can readily be opened from the inside at all times without the use of keys or any special knowledge or effort. The use of draw bolts is prohibited. All such doorways shall be entirely unobstructed.

Section 219. Marking Exits.

1. Every entrance and exit doorway opening from the auditorium shall have over the same on the auditorium side the word EXIT inscribed in legible letters not less than 6 inches high, or an illuminated sign with letters of the same

height. Auditorium entrances and exits shall be numbered with figures not less than 6 inches high.

2. No mirrors shall be so placed as to give the appearance of doorway, exit or passage. There shall be no false doors or windows.

Section 220. Diagrams of Exits. There shall be legibly printed on the program of each performance a separate diagram or plan of every tier. Each such diagram shall occupy a space not less than 15 square inches and shall show distinctly the entrances and exits from each tier and where they lead.

Section 221. Stair Landings. When stairs turn at an angle or return directly on themselves, a landing, without steps, of the full width of both flights, shall be provided. The outer line of landings shall be curved to a radius of not less than 2 feet; this provision, however, shall not apply to emergency exit stairs on outside of buildings. When two side stairways connect with one main stairway, the width of the main stairway shall be at least equal to the aggregate width of the side stairways. No stairway shall ascend to a greater height than 12 feet without a level landing, and the length and width of such landing shall be not less than the width of the stairs; no run of stairs shall consist of less than six risers between platforms.

Section 222. Stair Rails. All stairways shall have on both sides strong hand rails. Where stairways are built between walls, rails shall be firmly secured to the walls about 3 inches distant therefrom. All rails shall be about 3 feet above the treads. This provision shall also apply to all steps in side aisles of galleries. The width of all stairs shall be measured between hand rails. All stairways and landings between stories, when 7 feet and over in width, shall be provided with a center hand rail of metal, not less than 2 inches in diameter, placed at a height of about 3 feet above the treads and landings. Such rails shall be supported on metal standards securely bolted to the treads or risers of the stairs. At the head of the stairway at each story, a newel post shall be provided at least 6 feet in height, to which the rail shall be secured.

Section 223. Entrance Stairways.

1. No entrance stairway to any tier in the auditorium shall be less than 5 feet wide.

2. Entrance stairways and passages for the dressing rooms shall be at least 36 inches wide and extend independently to the street or court. No stairs in the stage section shall be less than 30 inches wide.

3. No door shall open immediately upon a flight of stairs, but a landing at least the width of the door shall be provided between such stairs and such door.

Section 224. Stairway Enclosures. All entrance stairways for the use of the audience (excepting those leading to the first gallery only, which may be open on one side) shall be enclosed with walls of brick or other fireproof materials in the stories through which they pass. There shall be no communication from any portion of the building above the street or court grade to any of said stairway enclosures except from the tier for which the stairway is exclusively intended. No stairway from a gallery shall communicate with the basement or cellar.

Section 225. Emergency Exit Stairways and Balconies. Emergency Exit stairways from each gallery shall be placed in smoke-proof towers, or an approved form of open air stairway may be used. The minimum width of emergency exit stairways shall be 4 feet, except that their width may be reduced 15 per cent. if located in a smoke-proof tower having no openings except to an outside balcony and to court grade. The stairways for the emergency exits from each tier shall extend to the court or street grade independently of the stairways or exits from other tiers. Outside balconies shall be at least as wide as the stairways which they serve, but in no case less than 6 feet. No riser shall be nearer than one foot to the door opening. See Figs. 10 and 14.

Section 226. Construction of Balconies and Stairways for Emergency Exits. All emergency exit balconies and stairways shall be constructed of steel or of other forms of incombustible construction approved by the Superintendent. Risers, treads, platforms and bal-

conies must be solid, without slats, and the construction shall be of strength sufficient to sustain safely a live load of 100 pounds per square foot with a safety factor of 4. Exterior stairways and balconies of steel construction shall be designed in conformity with the requirements of paragraph (2) Section 45. Sheet metal or other suitable solid material shall be provided to a height of not less than 4 feet on the outer side of all such open air stairways, balconies and platforms, and they shall be covered with a metal hood or awning constructed in a manner approved by the Superintendent. There shall be no openings in any theatre wall between the outside balconies or stairways and their covers, except the required exits from the tier served by said stairways and balconies. No person of the audience shall be obliged to pass alongside of more than one exit doorway after reaching an outside balcony to get to the ground. All exit stairways and balconies shall be kept free of obstructions of every kind, including snow and ice.

Section 227. Treads and Risers. All stairs shall have treads of uniform width, and risers of uniform height in each flight. The risers shall not exceed $7\frac{3}{4}$ inches in height nor shall the treads, exclusive of nosing, be less than $9\frac{1}{2}$ inches wide. No circular stairs shall be permitted, and no winders shall be introduced in any stairs which may be used for exit purposes.

Section 228. Exits from Stage Section. At least two independent exterior exits with direct outlet at court or street grade shall be provided from the stage level for the service of the stage and floors below same. These exits shall be at opposite sides of the stage and may serve also as entrances. Each tier of dressing rooms shall have an independent emergency exit leading directly to an open air stairway, or to a court or street. No ladder fire escapes shall be permitted. The fly galleries shall be provided with adequate means of exit. All exits from the stage section shall be independent of the exits for the audience above the court or street grade. Stairways, if any, leading down from stage level shall be enclosed and protected by fireproof doors.

Section 229. Emergency Courts. There shall be reserved for emergency exit purposes an open court or space on the side or sides of the building as follows:

- (a) In the case of a plot with streets on front, rear, and both sides, or in the case of a double corner plot where both sides of the theatre border on streets, no courts will be required. On a double corner, single corner, or inside plot when one side only of the building borders on a street, one court will be required located on the opposite side. On an inside plot where only the building front borders on the street, courts shall be provided on both sides.
- (b) In buildings used for motion picture shows and having no stage, the exits and courts above required may be replaced by equivalent exits and courts at the rear if consistent with the adequate distribution of the entire entrance and exit facilities.

Section 230. Court Width. The minimum width of open courts shall be 8 feet when the total capacity is 750 or less; 10 feet when the capacity is between 750 and 1000; and when the capacity exceeds 1000 people the width of the courts shall be increased one foot for each additional 500 people or fraction thereof in excess of 1000.

Section 231. Court Length. Said open court or courts shall extend at least from the line of the proscenium wall the length of the auditorium to the wall separating the same from the entrance lobby or vestibule. This entire court area shall be open to the sky, except that emergency exit stairways and smoke-proof towers may occupy part of the court space if the required width of exit passageways is not obstructed.

Section 232. Court Corridors. Where said emergency courts do not open directly on a street a separate and distinct corridor or passage shall continue directly to the street, around the building or through such structure as may be or may have been built on the street, but no such passageway shall pass under any portion of the auditorium or stage. Said corridors or passages shall be constructed fireproof all the way to the street in same manner as provided for the construction of corridors for entrances, in

Section 216, paragraph 3. The corridor or passage leading from the court to the street shall be at least as wide as the court, and there shall be no projections into the passage. The outer openings may be provided with doors or gates opening outward. During the performance these doors or gates shall be kept open; at other times they may be closed and fastened by movable bolts.

Section 233. Entrances in Courts. If entrances open on emergency courts or corridors the said courts or corridors shall be increased in width an amount at least equal to the width of the entrances which they serve.

Entrance vestibules to stage section, Sec. 242.

Section 234. Courts and Corridors Kept Clear. The courts or corridors or passages shall not be used for storage purposes, nor for any purpose whatsoever except for exit and entrance, and must be kept free and clear during performances.

Section 235. Gradients. All courts and corridors at points of street entrance or exit shall be flush with sidewalk. To overcome any difference of level in and between courts, corridors, lobbies, passages and aisles on the ground floor, gradients shall be employed of not over one foot in 10 feet, except that runs of not more than 10 feet in length may be one in 8.

Section 236. Proscenium Wall. A fire wall built of brick or concrete not less than 12 inches thick in any portion shall separate the auditorium from the stage and shall extend at least 4 feet above the stage roof, or the auditorium roof if the latter be higher. Any windows in the structure above the auditorium which face over roof of stage section when within 100 feet of the stage roof must be protected with fire shutters or fire windows. Above the proscenium opening there shall be a girder or other support of sufficient strength to safely carry the load. If a girder be used it shall be protected against fire by at least 4 inches of fire-proof material with special provision to reinforce or support it.

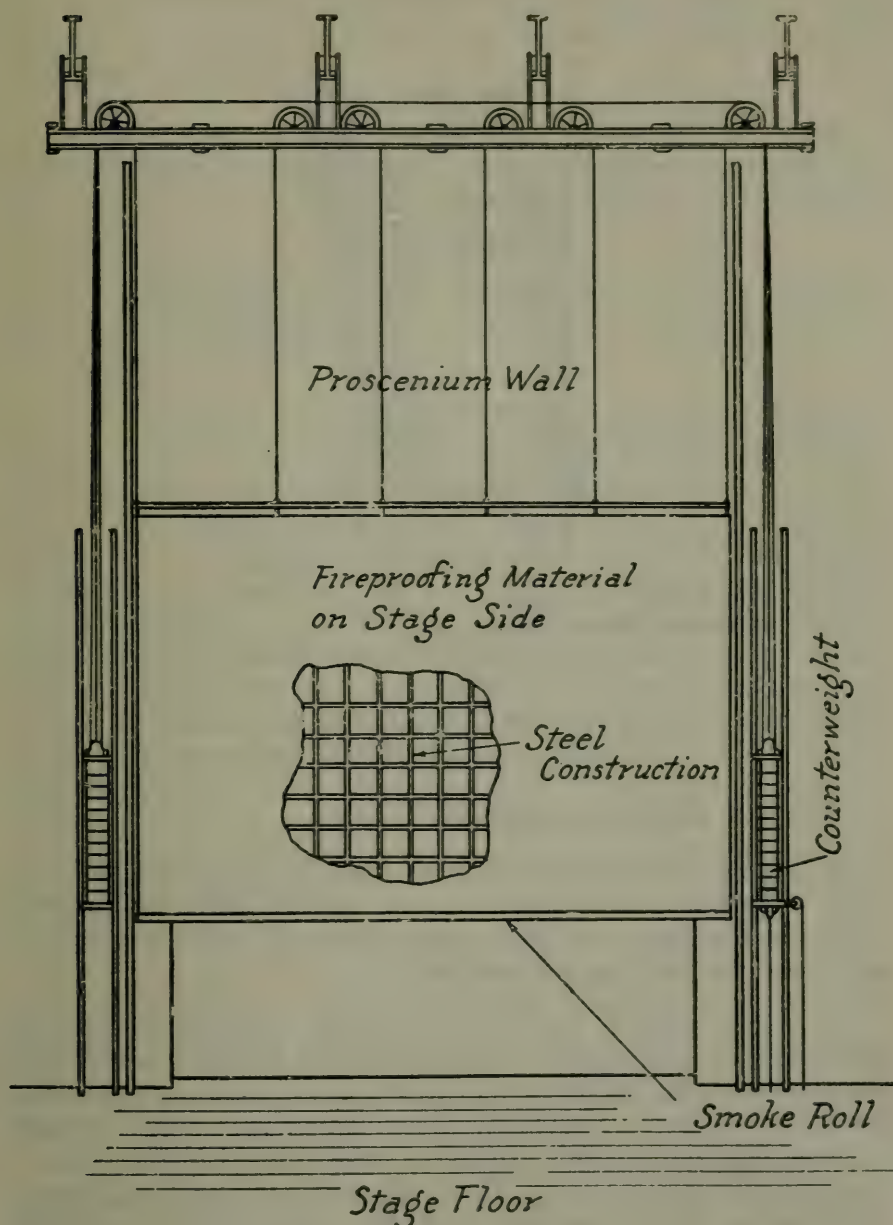


FIG. 36.

Diagram of a rigid theatre curtain designed to resist a severe stage fire; to entirely prevent the passage of flame from the stage section to the auditorium; and to reduce to a minimum the passage of smoke.

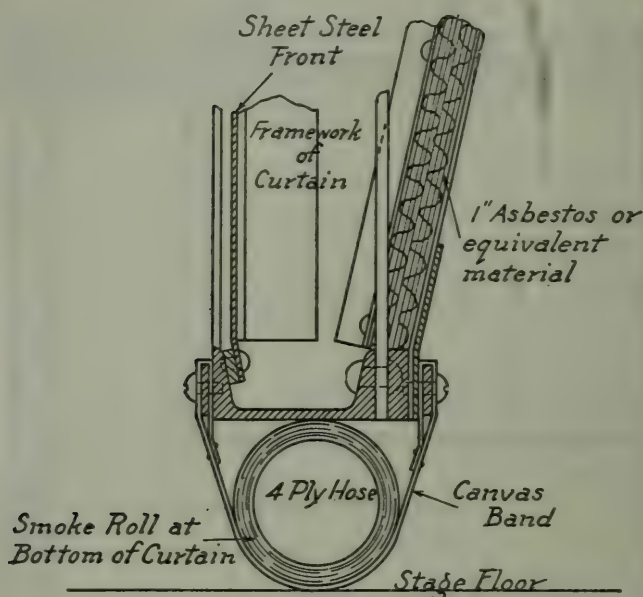
Detail of Smoke Seal at Bottom of Curtain

FIG. 37.

A method of attaching asbestos roll smoke seal to bottom of rigid curtain.

Section 237. Proscenium Curtain.

1. The proscenium opening shall be provided with a rigid fireproof curtain, built in conformity with the following specifications, or their equivalent in efficiency when approved by the Superintendent.

2. The curtain shall have a rigid, rivet-jointed, steel framework. The front or audience side of the frame shall be covered with sheet steel of a thickness not less than No. 20 U. S. gauge. The back shall be covered with vitrified cellular asbestos boards at least 1 inch thick, or other material equally fire resisting. Both coverings shall be securely attached to the framework and the joints properly sealed. The curtain shall be designed to resist a wind pressure of 10 pounds per square foot of surface without flexure sufficient to interfere with its closing. Fig. 36.

3. The thickness of the curtain shall be not less than 3

inches where the width of the proscenium wall opening is 30 feet or less; curtains for larger openings shall increase in thickness in proportion to the increase in width of opening they cover.

4. An asbestos roll of a diameter not less than one-half the thickness of the curtain shall be securely attached to the bottom of the curtain to form a smoke seal between the curtain and the stage floor. Figs. 36 and 37.

5. The curtain shall overlap the proscenium wall opening at least 12 inches at each side of the opening and not less than 2 feet at the top.

6. The guide members at the sides shall be rolled steel shapes, none of which shall be less than $\frac{3}{8}$ inch thick, and shall be of such character as to form a continuous smoke seal from top to bottom, with a clearance of not over $\frac{3}{8}$ inch. The guides shall be installed in such manner that in case of fire on the stage the pressure of heated gases against the curtain will act to close the guide joints tightly. Figs. 38 and 39. Provision shall be made to prevent the curtain from getting out of the guiding channel into which it shall project at least 2 inches. The proscenium wall shall have an offset at each side of the opening, so located and of such thickness and height as to be suitable for the attachment of the curtain guides. At least 1 inch shall be allowed at each edge of curtain to provide for lateral expansion.

Opportunity for expansion of the unprotected structural framework of the curtain and guides shall be furnished by slotting the holes of the connecting bolts.

NOTE.—As steel expands rapidly under action of heat, it is necessary to provide for the change in dimensions, otherwise disastrous deformations may result. In general an expansion of about $\frac{1}{8}$ inch per foot measured from fixed points should be calculated.

7. The wall over the proscenium opening shall be smooth and plumb to approximately the top of the curtain when it is down, and shall then offset at least 4 inches for the rest of its height, thus leaving a bench along the line of the top of the curtain between which a smoke seal shall be formed. Such a seal may conveniently be provided by arranging for the edge of a rolled steel shape attached to

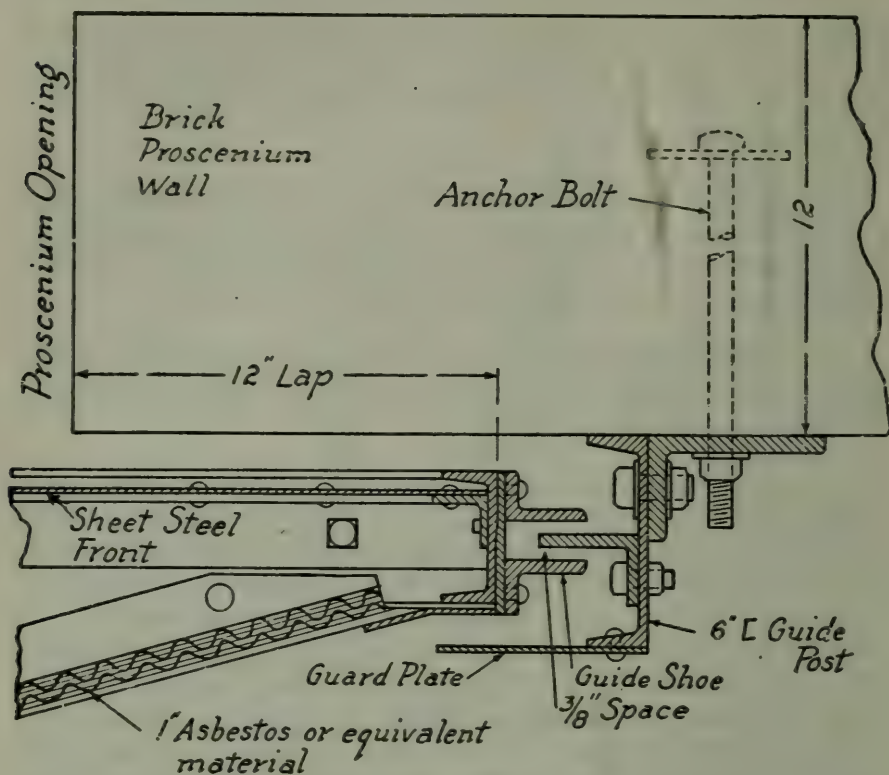


FIG. 38.

Diagram showing a method of constructing a smoke seal at side of a rigid curtain. A brick offset to support the guide would be better than this built-up metal structural member.

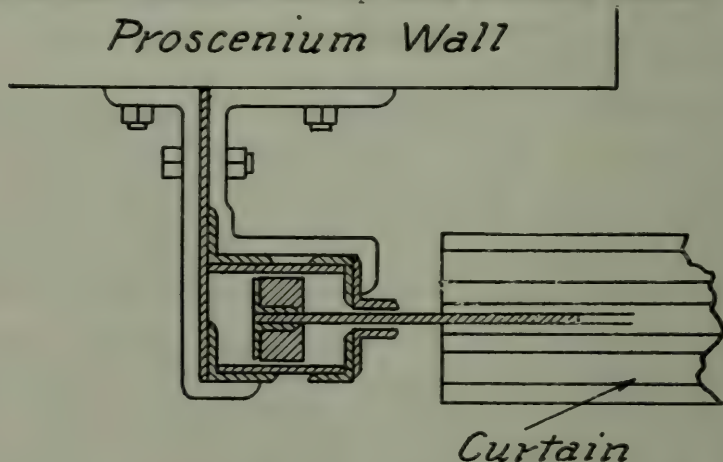


FIG. 39.

A second method of constructing the smoke seal at side of a rigid curtain.

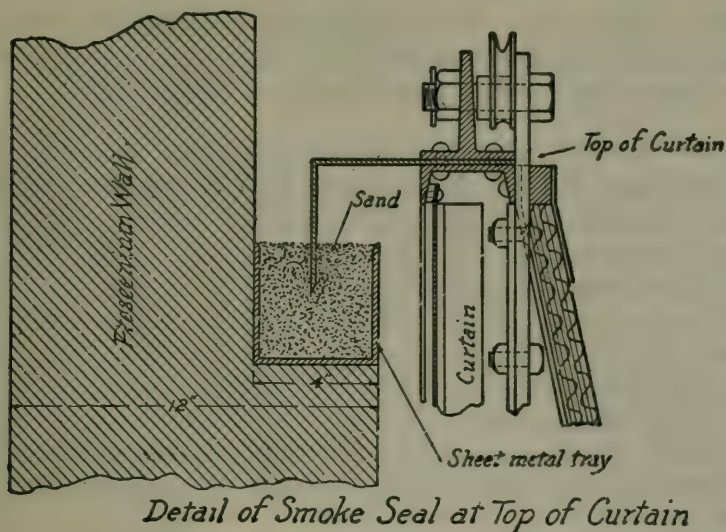


FIG. 40.

A method of constructing the smoke seal at top of rigid curtain.

the curtain to dip into a trough of sand resting on the bench. Fig. 40.

8. No part of a curtain or any of the curtain guides shall be supported by, or fastened to, any combustible material.

9. The hoisting apparatus for the curtain shall be designed with a factor of safety of 8.

10. The points for curtain suspension shall always be an even number, but never less than four. Two of the suspension points shall be located at the extreme ends of the curtain, and the others may be placed at such points as best suit the design, but in no case shall the distance between any two points of support exceed 10 feet.

11. Half of the cables attached to these points shall lead to one set of counterweights and half to another. The curtain shall be operated by hydraulic or other mechanism approved by the Superintendent. If hydraulic mechanism is used, the water may be taken from either the house tank or sprinkler tank supply. If from the latter, the supply pipe for curtain mechanism shall be so located in the tank that it cannot reduce the quantity of water below the amount necessary to fulfill the sprinkler requirements.

12. The device for controlling the curtain shall be simple in design, and capable of convenient operation from both sides of the stage and from the tie galleries.

13. The drop speed of the curtain shall be uniform and not less than 1 foot per second, but when the curtain is about $2\frac{1}{2}$ feet from the stage it shall automatically slow down so as to settle on the stage without shock. In addition to the regular operating mechanism, there shall be an emergency device which will cut off the power and allow the curtain to drop by gravity. This device shall be so arranged that it can be easily operated by hand from each side of the stage, under the stage, and in the tie galleries. The device shall also be so designed that its operation will be controlled by fusible links located at each of the above named points.

14. The audience side of the curtain may be decorated with a paint in which no oil is used. No combustible material shall be applied or attached to the curtain.

15. Drawings for every such curtain shall be submitted to the Superintendent, and be approved by him before it is erected.

NOTE.—A volume of smoke issuing from the stage section into the auditorium is liable to be as much of a panic breeder as actual flame. Numerous theatre fires have demonstrated that if the stage section could be completely isolated from the auditorium by a barrier sufficiently substantial to prevent passage of both smoke and flame, the danger to life from fire or panic would be very greatly diminished. The rigid curtain herewith described is designed to perform that function. Because of its merit as an efficient cut-off, many curtains of this type have been voluntarily placed in modern theatres in New York, Chicago, Philadelphia, and several other cities.

The method of installation of the ordinary flexible asbestos curtain is such that volumes of smoke can easily pass around the edges. Although such curtains will not burn, nevertheless when subjected to high heat they lose a large part of their strength and become fragile. In this condition they may be broken by falling scenery or from other causes, thus tending to make them unreliable in time of emergency.

A law which simply requires the installation of an asbestos curtain without specification as to quality is pernicious, for it permits the use of low grade material which would furnish but a small part of the protection the public is taught to expect.

Section 238. Counterweights. Where counterweights are used they shall be suspended at the extreme side or other walls of the stage section, and be enclosed by guards.

Section 239. Other Openings in Proscenium Wall. Openings between the stage and auditorium other than the proscenium opening shall not exceed four in number; two at the approximate stage level and two in the musicians' pit; the size of any such opening shall not exceed 21 square feet. The openings at stage level shall have an automatic fire door on one side of the wall and self-closing fire door on the other side of the wall; openings, if any, below the stage shall have a self-closing fire door; all of said doors shall be hung so as to be opened from either side of the wall at all times.

Section 240. Overhang of Stage. All that portion of the stage extending from the stage inside of the curtain and from the wall separating the space under the stage from the auditorium, to the outer edge of the apron shall be fireproof. A wood finish floor without air space may be used on the stage in front of the curtain.

Section 241. Openings in Exterior Walls. All openings in exterior walls of stage section shall be protected by approved fire doors, shutters, or windows.

Section 242. Vestibules for Stage Entrances. All entrances to the stage from streets, alleys, or open courts shall be vestibuled to protect the stage from drafts of air.

Section 243. Fireproof Stage Construction. All that portion of the stage which is not movable (excepting that part usually embraced between the proscenium jambs and from proscenium to rear wall) shall be of fireproof construction and designed to safely sustain a live load of not less than 100 pounds per square foot. The non-fireproof portion of stage floor shall be of heavy timbers or steel beam construction with flooring not less than $1\frac{3}{4}$ inch finished thickness.

Section 244. Fly and Tie Galleries. The fly galleries and the tie galleries shall be of fireproof construction designed to safely sustain a live load of 90 pounds per square foot. No wooden boards or sleepers shall be used as a covering over these floors.

Section 245. Gridiron. The gridiron or rigging loft shall have a lattice metal floor capable of sustaining a live load of 75 pounds per square foot and be readily accessible by metal stairs or ladder.

Section 246. Scenery. All stage scenery, curtains, and decorations made of combustible material, and all woodwork on or about the stage, shall be painted or saturated with some non-combustible material, or otherwise rendered safe against fire.

Section 247. Ventilation in Stage Section.

1. There shall be one or more ventilators, constructed of metal or other incombustible material, near the center and above the highest part of the stage of every theatre, raised above the stage roof, and of a combined sectional area equal to at least 10 per cent. of the floor area within the stage walls. The openings in such ventilators shall have an aggregate sectional area at least equal to that required for the ventilators. Detailed drawings showing the construction and operation of the ventilators must be approved by the Superintendent before installation is begun. The entire equipment shall conform to the following requirements or their equivalent:—

2. The construction of the cover and its operating mechanism shall be massive, and the cover shall open by force of gravity sufficient to effectively overcome the effects of neglect, rust, dirt, frost, snow or expansion by heat, or warping of the framework.

3. Glass if used in ventilators must be protected against falling on the stage. A wire screen if used under the glass must be so placed that if clogged it cannot reduce the required vent area or interfere with the operating mechanism, or obstruct the distribution of water from the automatic sprinklers.

4. The cover shall be arranged to open instantly after the outbreak of fire by the use of approved automatic fusi-

ble links of the thinnest metal practicable; manual control also must be provided by a cord run down to the stage at a point designated by the Superintendent.

5. The link and cord must hold the cover closed against a force of at least 30 pounds excess counterweight tending to open the cover. Fusible links shall be placed in the ventilator above the roof line and in at least two other points in each controlling cord. No automatic sprinkler heads shall be placed in the ventilator space above the fusible links. While theatre is in use, each ventilator cover shall be operated daily by one of the cords.

Section 248. Skylights. If any skylight is placed in a roof, it shall be installed in accordance with the requirements of Section 86.

Section 249. Dressing Rooms.

1. Actors' dressing rooms shall not be placed on or under the stage, or in or under the auditorium. They shall be in a separate section provided for that purpose. No dressing room ceiling shall be less than 4 feet, 6 inches above the level of street or court adjoining.

2. The walls separating the section containing the dressing rooms from the stage or auditorium shall be of brick or concrete not less than 8 inches in thickness and each opening therein shall be protected with a self-closing fire door. The partitions dividing the dressing rooms, together with the partitions of every passageway from the same to the stage shall be constructed of approved fireproof material not less than 4 inches in thickness. All doorways in any of said partitions shall be protected by self-closing fire doors. All dressing rooms shall be ventilated by fire windows to a street or to a court not less than 24 square feet in area.

3. All shelving and cupboards in every dressing room, property room or other storage rooms, shall be of incombustible material.

Section 250. Heating Apparatus.

1. Steam boilers shall be located outside of the buildings, either under the sidewalk or in an extension, but in no case under or within any portion of the building; the

space allotted to the same shall be enclosed by walls of brick or concrete at least 12 inches thick on all sides, and the ceiling of such space shall be constructed of fireproof materials. Each doorway in said walls connecting with the building shall have an automatic fire door.

2. No floor register for heating, ventilating or other purposes shall be permitted in aisles, corridors or passageways.

3. All blowers used to circulate air through heating or ventilating pipes with openings to the auditorium shall be provided with a device to stop the blower automatically in case of fire. The device for this purpose shall be located near the blower, both inside and outside the pipe leading to openings in the auditorium. See note in Section 184.

4. No coil, radiator or pipe shall be placed so as to obstruct any aisle or passageway. Any exposed radiator or coil shall be guarded.

Section 251. Lighting.

1. The stage section and every portion of the building devoted to the uses or accommodation of the public, also all passages leading to streets, including the open courts and corridors, shall be satisfactorily lighted during every performance, and until the entire audience has left the premises.

2. Only electric light shall be used in the auditorium and stage section, except that gas fixtures having not larger than "1 foot" burners may be used in dressing rooms. These shall have soldered to the fixture strong wire guards or screens not less than 10 inches in diameter, so constructed that any material in contact therewith shall be out of reach of the flames.

3. Where electric current from two separate street mains is available, two separate and distinct services shall be installed; one service to be of sufficient capacity to supply current for the entire equipment of the theatre, while the other service must be at least sufficient to supply current for all emergency lights, including the exit lights or signs, and all lights in outside courts, lobbies, stairways, corridors, and other portions of the theatre which are normally kept lighted during the performance. Where only one

supply from a street main is available the connections used exclusively for emergency lights must be taken from a point on the street side of the main service fuses. When the source of supply is an isolated plant on the same premises, an auxiliary service at least sufficient to supply all emergency lights shall be connected with some outside source, or a suitable storage battery within the premises may be considered the equivalent of such service.

4. Where illuminated signs are not provided there shall be at least one green light over each exit and entrance opening from the auditorium and stage sections. See note in Section 44, paragraph 8.

5. All emergency lights shall be controlled by a special switch located in the lobby and accessible only to authorized persons.

6. The stage switchboard shall have a metal hood over the top, running the full length of the board and fully protecting same from anything falling from above.

Section 252. Automatic Sprinkler Equipment.

1. A standard wet-pipe system of approved automatic sprinklers shall be installed throughout the theatre, except in the auditorium, foyers and lobbies. Sprinklers shall not be permitted over dynamos and switchboards or above the fusible links immediately under the automatic ventilators over stage.

2. Sprinkler equipments shall be installed in accordance with the requirements of Section 195.

Section 253. Standpipes.

1. Standpipes conforming to the requirements in Section 194 shall be provided with hose connections located as follows: One on each side of the stage on each tier, one readily accessible from the property room, the carpenter shop, scenery storage rooms, lobbies and elsewhere as may be required by the Superintendent.

2. A sufficient quantity of approved linen hose, 1½ inches in diameter, in 50-foot lengths or enough to cover floor area, shall be kept attached to each hose connection; 25-foot lengths will be permitted in fly galleries.

Section 254. Miscellaneous Fire Appliances.

1. There shall be on each side of the stage two axes, one 20 foot, one 15 foot, and one 10 foot hook, as designated by the Fire Department. On each side of the stage, under the stage, on each fly gallery, also in property and other store rooms, and in each workshop, there shall be kept in readiness for immediate use one approved $2\frac{1}{2}$ gallon hand chemical fire extinguisher and one 40 gallon cask filled with water, and six fire pails; said casks and buckets shall be painted red and lettered "For Fire Purposes Only." There shall also be provided at least three approved $2\frac{1}{2}$ gallon hand chemical fire extinguishers for each tier of the auditorium.

2. All apparatus for the extinguishment of fire shall be installed in accordance with the rules of the Fire Department and be kept at all times in condition satisfactory to and under control of the Fire Department.

PART XXXII.**CONSTRUCTION OF MOVING PICTURE THEATRES HAVING CAPACITY OF THREE HUNDRED OR LESS.****Section 255. Requirements for Exhibition Room.**

1. No motion picture machine shall be installed, maintained or operated in any building that does not abut directly upon a street; nor shall any such machine be installed, maintained or operated in connection with any exhibition room contained in a building occupied as a hotel, tenement house, or lodging house; nor in factories or workshops, except where the exhibition room and motion picture machine are separated from the rest of the building by unpierced fire-proof walls and floors; in no case shall the main floor of such exhibition room be more than 4 feet above or below the adjoining grade level. To overcome any difference of level on the ground floor gradients shall be employed of not over one foot in 10 feet; no steps shall be permitted. Exit doors shall be at the same level as the sidewalks.

2. If the walls of the auditorium contain wooden studs, they shall be protected with metal lath and not less than $\frac{3}{4}$ -inch of cement or cement-tempered plaster, or be covered with $\frac{1}{2}$ -inch plaster boards and plastered with

$\frac{1}{4}$ inch of plaster or covered with metal. The joints shall be properly filled with mortar. The ceilings of all such auditoriums having wooden construction, and the ceilings of any basement or cellar which may exist under such auditoriums, shall be protected with metal lath and cement plaster or with $\frac{1}{2}$ inch plaster board and covered with plaster or metal as above specified for protection of walls. All metal lath used in such construction shall be of quality specified in Section 113.

3. All motion picture exhibition rooms shall be provided with at least two separate exits, one of which shall be in the front and the other in the rear, both leading to unobstructed outlets on the street. The aggregate width in feet of such exits shall be not less than one-twentieth of the number of persons to be accommodated thereby. No exits shall be less than 5 feet in width, and there shall be a main exit not less than 10 feet in total width.

4. If an unobstructed exit to a street cannot be provided at the rear of such buildings, as herein specified, either an open court or a fireproof passage or corridor shall be provided from rear exit to the street front, of at least 4 feet in width for exhibition rooms accommodating fifty persons or less, and 6 inches additional for each additional fifty persons accommodated by such room. Such passage shall be constructed of fireproof material and shall be at least 10 feet high in the clear. The walls forming such passage shall be at least 8 inches thick, of brick or other approved fireproof material, and if there be a basement the wall on the auditorium side shall either extend 1 foot below the cellar bottom or may be carried in the cellar on iron columns and girders properly fireproofed. The ceiling of said passages, and, if there be a basement, the floor, shall be of fireproof construction.

5. If unobstructed rear exits or exits to a street are provided, the said exit or exits shall be of the same total width required for the court or passage above mentioned. Said passages and exits to the street shall be used for no other purposes except for exit and entrance, and shall be kept free and clear.

6. The level of the open court or passage where it intersects the street shall be not greater than one step

above the level of the sidewalk, and the grade shall be not more than 1 foot in 10, with no perpendicular rises.

7. All seats in any exhibition room for moving picture machines shall be not less than 32 inches from back to back, measured horizontally, and securely fastened to the floor; they shall be so arranged that there will be not more than ten seats in a line between aisles, nor more than four between any seat and an aisle. All aisles shall lead directly to exits and all exits shall be directly accessible to aisles. No aisle shall be less than 3 feet in width where it begins, and shall increase in width toward the exits 3 inches for every 10 feet in length. All exit doors shall be arranged to swing outward and be provided with fastenings that can be opened readily from the inside, without the use of keys or any special effort. Such doors shall not be locked when the room is open to the public.

8. All the requirements of this section relating to seats, aisles, passageways, exits and doors shall apply in connection with each open-air motion picture exhibition.

9. Every exit doorway leading from exhibition room shall have over the same on the auditorium side, the word "EXIT" in letters not less than 6 inches high, or an illuminated sign with letters of the same height. Where illuminated signs are not provided there shall be at least one green light over each exit doorway. The exit doorways shall be numbered with figures not less than 6 inches high. Lights used in marking exits or lighting passageways, stairways or inclines leading from them shall not depend upon or be controlled by wires, switches or fuses located in room, compartment, booth or enclosure containing motion picture machines, but shall be controlled from ticket office. See note in Section 44, paragraph 6.

10. Any motion picture exhibition room accommodating more than 300 people, or containing a gallery or galleries, shall be built in compliance with the requirements for theatres. Sections 196-254.

NOTE.—For detailed information concerning protection from hazard of moving picture machines, see "Suggested Ordinance to Regulate the Installation, Operation, and Maintenance of Moving Picture Machines", adopted by the National Board of Fire Underwriters and the National Fire Protection Association.

PART XXXIII.

ASSEMBLY HALLS.

Section 256 Requirements for Public Safety.

1. In all buildings or parts of buildings occupied for purposes of assembly, other than theatres, which are provided for in Sections 196 to 255 inclusive, the halls, doors, stairways, passageways, and all other exit facilities shall conform to the provisions of this Code as provided for in Sections 44-47.

2. All seats shall be spaced as required for theatres. In computing the seating capacity of any room or building used for purposes of assembly in which the seats are not fixed, an allowance of 6 square feet of floor area shall be made for each person and all space between the walls or partitions of such room or building shall be measured in this computation. Movable seats are not permitted in balconies and galleries having stepped floors.

3. Any assembly hall containing a stage shall comply with the requirements for theatres, except that stages the area of which do not exceed one-fifth the area of the auditorium and having no transient scenery other than especially approved by the Superintendent, may conform to the following requirements: The proscenium wall may be built as required for fireproof partitions, Section 115. All allowed openings in the proscenium wall except the curtain opening shall be protected by approved fire doors. The curtain in such assembly halls may be of asbestos instead of the rigid theatre curtain and shall be hung on incombustible supports. All scenery, borders, and wings shall be rendered non-inflammable as provided in Section 246.

PART XXXIV.

PLUMBING, DRAINAGE AND ELECTRICAL REQUIREMENTS.

Section 257. Plumbing and Drainage.

1. The plumbing and drainage of all buildings, both public and private, shall be performed in accordance with the rules and specifications of the Department of Buildings, and the Department of Health.

Said rules and specifications and any change thereof shall be published in one daily newspaper to be designated by the Mayor, for eight successive Mondays before the same shall become operative.

2. Repairs or alterations of such plumbing or drainage may be made without the filing and approval of drawings and descriptions in the Department of Buildings, but such repairs or alterations shall not be construed to include cases where new vertical or horizontal lines of soil, waste, vent or leader pipes are proposed to be used.

Notice of such repairs or alterations shall be given to the said Department before the same are commenced in such cases as shall be prescribed by the rules and specifications of the said Department, and the work shall be done in accordance with the said rules and specifications.

3. It shall be unlawful to use any new system of plumbing and drainage in any building before the same has been tested and approved by the Superintendent of Building Construction, and until an adequate water supply has been provided.

Section 258. Registration of Plumbers.

1. A master or employing plumber within the meaning of this Code is any plumber who hires or employs a person or persons to do plumbing work.

2. Once in each year, every employing or master plumber carrying on his trade or business in the city of., shall register his name and address at the office of the Department of Buildings under such rules and in such manner as the Superintendent of Building Construction shall prescribe. Thereupon he shall be entitled to receive a certificate of such registration from said Superintendent.

3. The time for making such registration shall be during the month of March in each year, but this shall not preclude a person from registering and obtaining a certificate of competency at any other time, but he shall also register in the month of March in each year as herein provided.

4. Such registration may be cancelled by the Superintendent for a violation of the rules or specifications for plumbing or drainage of said Department, duly adopted and in force pursuant to the provisions of this section, or when-

ever the person so registered ceases to be a master or employing plumber, after a hearing had before said Superintendent and upon a prior notice of not less than ten days, stating the grounds of complaint and served upon the person charged with violation of the aforesaid rules or specifications.

5. After this Code takes effect, no person, corporation or co-partnership shall engage in or carry on the trade, or business of employing master plumber in the city of.
....., unless the name and address of such person and the president, secretary or treasurer of such corporation and each and every member of such co-partnership shall have been registered as above provided.

6. No plumbing and drainage or any part thereof shall be commenced until the plumber who is to do the work shall sign the specifications and make affidavit that he is duly authorized to proceed with the work. Affidavit must give the name and address of owner and plumber. No registered plumber shall sign the specifications and act as the agent for a plumber who has not obtained a certificate of competency from the Examining Board of Plumbers as an Employing or Master Plumber. A violation of this rule will be deemed a sufficient reason by the Superintendent for the cancellation of a Certificate of Registration.

7. No person shall expose the sign of "plumber" or "plumbing," or a sign containing words of similar import and meaning, in the city of.....unless such person shall have registered and obtained a certificate as herein provided.

Section 259. Gas, Water and Steam Pipes.

1. Every building, in which gas or steam is used for lighting or heating, shall have each supply pipe leading from the street mains provided with a heavy brass straight-way stopcock or valve placed in the sidewalk at or near the curb, and arranged to permit shutting off at that point.

2. No gas, water, or other pipes shall be let into wooden beams unless placed within 36 inches of the end of the beams, and in no case shall the pipes be let into any beam more than one-fifth of its depth.

Section 260. Installation of Gas Pipes and Gas Appliances.

1. All outlets and risers shall be left capped until covered by fixtures.
2. No unions or running threads shall be permitted. Where necessary to cut out for repair of leaks, or making extensions, pipe shall be again put together with right and left couplings.
3. All gas burners shall be placed at least 3 feet below any woodwork or ceiling attached to wooden beams, unless the same is properly protected by a shield, in which case the distance shall be not less than 18 inches.
4. No swinging or folding gas bracket shall be placed against or near any stud partition or woodwork.
5. No gas bracket on any lath and plaster partition or woodwork shall be less than 6 inches in length measured from the burner to the plaster surface or woodwork.
6. Gaslights placed near window curtains or any other combustible material shall be guarded by globes or wire cages.
7. Gas connections to stoves and similar heating devices shall be made by rigid metal pipes. For small portable gas heating devices, flexible metal or rubber tubing may be used when there is no valve or other shut-off on the device.
8. All gas, gasoline, oil, or charcoal burning stoves or heating devices shall be placed on iron stands at least 6 inches above combustible supports, unless the burners are at least 5 inches above the base with metal guard plates 4 inches below the burners.
9. No open flame heating or lighting device shall be used in any room where gasoline or other volatile inflammable fluids are stored or handled.
10. After all piping is installed and all outlets capped, there shall be applied by the plumber in the presence of an inspector of the Department of Buildings, a test with air to a pressure equal to a column of mercury 6 inches in height, and the same to stand for five minutes; only mercury gauge shall be used. No piping shall be covered, nor shall any fixture, gas heater or range be connected thereto until a card

showing the approval of this test has been issued by the Superintendent.

11. No meter shall be set by any gas company until a certificate is filed with them from the Department of Buildings certifying that the gas pipes and fixtures comply with the foregoing rules.

Section 261. Electrical Installations. All electrical wiring, apparatus, or appliances for furnishing light, heat, or power, shall be in accordance with the current issue of the "National Electrical Code," and no installation of electrical equipment shall be made, except in conformity thereto.

PART XXXV.

REGULATIONS GOVERNING THE CONSTRUCTION AND OPERATION OF ELEVATORS.

Section 262. Construction and Operation of Elevators.

1. The term *elevator* as used in this Code shall include all elevators, escalators or lifts used for carrying passengers or freight. The term *dumbwaiter* shall include such special form of elevator, the dimensions of which do not exceed 6 square feet in horizontal section, and 4 feet in height, and which is used for the conveyance of small packages and merchandise.

Any hand power elevator having a rise of more than 35 feet shall comply with all the requirements of this section. No belt elevators driven from a countershaft shall be installed for passenger service.

2. Before any elevator shall hereafter be installed or altered in any building, the owner shall submit, on appropriate blanks furnished therefor, to the Superintendent an application in triplicate stating the construction and mode of operation of such elevator to be installed or altered, accompanied by such plans and drawings as may be necessary, and shall obtain his approval therefor. Before any such elevator shall be put into service, the same shall have been duly tested and inspected by the Superintendent and a certificate of inspection and approval obtained. In making any changes or alterations to ele-

vator shafts, rails, overhead machinery or power, all the work changed or altered shall be made to conform to these regulations.

Application in triplicate, Sec. 5, par. 1, Note.

3. The owner of any elevator now in operation and the manufacturer of any such elevator hereafter placed in any building, shall cause to be fastened in a conspicuous place in said elevator, a metal plate having suitable raised letters on same which shall designate the number of pounds which said elevator shall be permitted to carry, but in no case shall a carrying capacity of less than 100 pounds per square foot of platform area inside the car be permitted on any passenger elevator.

4. Every elevator, except full automatic push button elevators, shall be in charge of a competent, reliable, operator not less than eighteen years of age, who shall have had at least one week's experience in running an elevator under the constant supervision of a person who has received a certificate of competency as an elevator operator.

5. No person shall run any passenger or freight elevator in the city of unless he shall first register at the office of the Department of Buildings his name and residence, also the location of the building in which he is to perform such service, and shall first receive from the Superintendent a certificate of competency.

6. Not more than one door opening in the elevator shaft shall be allowed on each floor, and all openings in the several stories shall be one above the other, except where the operating device of the elevator is so placed that the operator can readily control all doors without leaving the car control, in which case more than one door opening may be permitted on a floor.

7. All elevators hereafter installed in vertical shafts shall be controlled by some mechanical device that will automatically prevent the car being moved until the shaft door or gate at which the car is standing is shut and securely fastened, and which will prevent the opening of any shaft door or gate until the car has come to rest at the landing. All doors or gates opening into existing elevator shafts shall be locked or bolted in manner to permit opening only by the operator of the car.

NOTE.—Statistics covering many years show that about 90 per cent. of all elevator accidents occur as a result of the lack of equipment to protect the doorways as specified in the above paragraph. It is recommended that an ordinance be enacted requiring all existing elevators to be equipped with such a device within a certain specified date.

8. All counterweights shall have their sections strongly bolted together. There shall be not less than 3 feet clearance between the top of counterweights and the under side of overhead beams when the car is resting on the bumpers. No continuous forged straps shall be permitted on counterweights.

9. Elevator cars shall be constructed of incombustible materials, except that flooring may be of hardwood. There shall be not more than $1\frac{1}{4}$ inches space between the floor of the car and the floor saddles, and where the saddles project into the shaft the same shall be properly beveled on the under side. The under side of the car shall be of incombustible materials. Cars for all elevators shall be properly lighted.

10. All guide rails for both car and counterweights shall be of steel, and shall be bolted to the sides of the shaft with steel or cast-iron brackets, so spaced that the guide rails will be rigid. The splices in the rails shall be located as near such rigid supports as possible.

11. No passenger elevator shall be permitted to have a freight compartment attached to it in any manner.

12. Immediately under the sheaves at the top of every elevator shaft in any building, there shall be provided a concrete slab or substantial grating of steel having not more than one inch space between the members of said grating, and of such construction as shall be approved by the Superintendent.

13. A clear space of not less than 3 feet shall be provided between the bottom of the shaft and the lowest point of the under side of the car floor when the car is at its lowest landing; and between the top of the crosshead of the car and the under side of the overhead grating when the car is at its top landing; except that this latter space shall be not less than 5 feet for elevators having a speed in excess of 350 feet per minute, and may be reduced to 2 feet for elevators having a total rise not exceeding 30 feet, and a speed not exceeding 100 feet per minute.

14. All parts of the elevator machinery shall be enclosed by suitable partitions of incombustible materials, and such inclosures shall be lighted. Free and safe access shall be provided to all parts of elevator machinery. Where the machine is located at the bottom of the shaft it shall be protected with a substantial pit pan.

15. At the top and bottom of all elevator shafts there shall be placed substantial buffer springs for car and counterweights.

16. The carrying beams and other supports for all machinery shall be of steel designed for double the live loads to be supported.

17. Every passenger elevator shall have a trap door in the top of the car of such size as to afford easy egress for passengers, or where two cars are in the same shaft such means of egress may be provided in the side of each car.

18. The Superintendent of Building Construction shall cause an inspection of elevators carrying passengers or employes to be made at least once every three months, and shall require any necessary repairs to be made promptly by the owner. If the Superintendent at any time considers an elevator to be unsafe, he may require its operation to cease until such repairs or alterations have been made as will in his judgment produce safety. In lieu of such inspection by his own Department, the Superintendent may accept the report of inspections made by other reliable and properly constituted authorities which in his judgment are competent and satisfactory.

19. In every building exceeding 100 feet in height, at least one passenger elevator shall be kept in readiness for immediate use by the fire department during all hours of the night and day, including holidays and Sundays.

20. It shall be unlawful to use any elevator that is not provided with safety devices for bringing the elevator car to rest without serious injury to passengers or operators whenever it may for any reason exceed its rated speed by more than forty per cent. or reach a speed of 850 feet per minute. Safety devices are not required upon the plunger type of elevators, nor upon sidewalk elevators which travel less than 30 feet.

21. The Superintendent shall issue and enforce such other regulations regarding the construction, erection, operation or repair of elevators as he may consider necessary to insure safety. Such regulations being promulgated in accordance with the requirements of Section 316.

Enclosures for elevators, Sec. 90.

PART XXXVI.

SIGNS AND BILLBOARDS.

Section 263. Signs and Billboards.

1. Wooden signs or billboards may be permitted as follows:

- (a) When not exceeding 14 feet in height above the curb level, with a clear space of not less than 3 feet between the bottom of the sign or billboard and the ground. Such signs or billboards shall be securely attached to posts or other supporting structure and shall be located entirely within the lot lines.
- (b) When not exceeding 2 feet in height and fastened flat against the wall of a building, or in front of or on top of the cornice over a first story show window, or on top of a wall of the building.
- (c) When exceeding 2 feet in height but not exceeding 40 square feet in area and fastened flat against the wall of a building.
- (d) All signs attached to a building shall be fastened directly to the walls by well secured metal anchors. Wooden supports or braces shall not be permitted, nor shall such wooden signs have electric lights or fixtures attached to them in any manner.

2. All other signs or billboards within the fire limits shall be entirely constructed of incombustible materials, including all supports and braces for same.

3. Any letter, word, model, sign, device or representation in the nature of an advertisement, announcement or direction, supported or attached wholly or in part over or above any wall, building or structure, shall be deemed to be a sky-sign. Except as herein specified sky-signs shall be

constructed entirely of metal, including the supports and braces for same, and no sky-sign shall project beyond the building line.

4. Within the fire limits no sky-sign shall be supported, anchored or braced to the wooden beams or other framework of a building which is over three stories high.

5. No sign attached to the side of a building or structure fronting upon a public thoroughfare shall project more than 5 feet outside the building line.

6. Sky-signs shall be set back at least 8 feet from the cornice or wall on a street front, shall not project more than 25 feet above the roof of a building, and shall have a space at least 6 feet in height between the bottom of the sign and the roof.

All such signs shall be designed to withstand a wind pressure of at least 30 pounds per square foot of surface.

7. No sign or billboard shall be so constructed as to obstruct any door, window or fire-escape, on any building.

8. Before the erection of any sign or billboard shall have been commenced, a permit for the erection of the same shall be obtained from the Superintendent. Each application for the erection of any sign or billboard shall be accompanied by a written consent of the owner or owners, or the lessee or lessees of the property on which it is to be erected.

9. This section shall apply to all signs hereafter erected whether placed upon new or existing buildings.

PART XXXVII.

PROTECTION OF WORKMEN AND THE PUBLIC.

Section 264. Provision for Safety.

1. Fireproof floor construction shall follow up the erection of the steel framing of all structures within two complete tiers.

2. If filling with brick or other fireproof material is not required between floor beams, the under flooring or other planking shall be laid in each story as the building progresses.

3 If the floor construction is of structural steel, the contractor for the steel work or the owner of building in course of erection shall thoroughly plank the entire tier of steel beams on which the structural steel work is being erected, except such spaces as may be reasonably required for hoisting materials and other erection work.

4. All openings in the floor framing intended for stairways, elevators or for other shafts shall be planked over or enclosed on all sides to a height of at least 3 feet.

5. If elevating or hoisting apparatus is used for the purpose of lifting materials within a building under construction, the shafts or openings in each floor shall be inclosed or fenced by a substantial barrier at least 6 feet high, except two sides for the handling of materials. These sides shall be guarded by an adjustable barrier not less than 3 feet high above the floor and not less than 2 feet from the edge of such shaft or opening.

Section 265. Strength of Temporary Supports. Every temporary support placed under any structure, wall, girder or beam, during the erection, alteration, demolition, or repair of any building or structure or any part thereof, shall be of sufficient strength for safely carrying the load to be placed thereon.

Section 266. Overloading to be Avoided. During the construction or alteration of any building or structure no material entering into such construction or alteration shall be placed on any floor in excess of the live load that such floor is intended to safely sustain.

Section 267. Outside Scaffolds. Whenever outside scaffolds are used on buildings over 40 feet in height, whether they be suspended or constructed of poles and thrustouts, they shall be provided with a substantial guard railing or enclosure of wire mesh or other suitable material, extending 4 feet above the working platform on its outer edge and ends. All such scaffolds shall be constructed in a manner to secure the safety of the workmen on them and the people using the street.

Section 268. Shed for Protection of Pedestrians. When buildings or any part thereof are erected or increased

in height to over 40 feet upon or along any street, the person erecting or altering such building shall erect and maintain an approved substantial shed from the area line to the curb for the full frontage of the building. No shed shall be required when a building is erected 10 feet or more back of the building line. The street side shall be kept open for a height of not less than 6 feet 6 inches above the curb, and the shed shall be kept properly lighted at night.

PART XXXVIII.

TENEMENT HOUSE LAW.

Section 269. Scope of Law.

1. An ordinance controlling the construction and use of tenement and apartment houses.

2. This ordinance shall be known and cited as the Tenement House Law and provides regulations affecting the light, ventilation, protection from fire, means of egress, and sanitation of tenement houses. Except as herein otherwise provided, every tenement house shall be constructed and maintained in conformity with the special provisions of this ordinance, and in accordance with all other requirements of this Code of which the Tenement House Law forms an integral part.

NOTE.—The sections of this Ordinance which treat of yards, courts, and percentage of lot area covered, prescribe only the minimum requirement generally conceded to be necessary for adequate light and ventilation. They should therefore be followed only in the larger cities where land values are high. It is recommended that wherever possible, the percentage of uncovered spaces be increased.

Section 270. Definitions Particularly Applicable to Tenement Houses.

1. A *tenement house* is any house or building, or portion thereof, which is either rented or leased, to be occupied, in whole or in part, as the home or residence of three or more families living independently of each other, and doing their cooking upon the premises; and having a common right in yards, hallways, stairways, etc.; and includes apartment houses, flat houses and all other houses so occupied.

2. A *yard* is an open unoccupied space on the same lot with a tenement house, between the extreme rear line of the house and the rear line of the lot.

3. A *court* is an open unoccupied space, other than a yard, on the same lot with a building. A court not extending to the street or yard is an inner court. A court extending to the street or yard is an outer court. If it extends to the street it is a street court. If it extends to the yard it is a yard court.

Section 271. Class of Construction Required.

1. *Fireproof Tenements.* Every building erected or altered for use as a tenement house exceeding 55 feet in height shall be constructed fireproof in accordance with the requirements of this Code for fireproof buildings.

Requirements for fireproof buildings, Sec. 110.

2. *Non-Fireproof Tenements.* All non-fireproof tenement houses erected or altered having a height of three stories or more exclusive of the cellar, or if there be no cellar, exclusive of the lowest story, shall have the first floor above the cellar or lowest story of fireproof construction.

Frame tenements, Sec. 301.

3. All tenement houses erected or altered in which the first floor over the cellar or lowest story is not required to be of fireproof construction shall have the cellar ceiling protected as specified in Section 99, paragraph 5.

Non-fireproofing buildings used for business and residence, Sec. 98.

Frame buildings outside fire limits, Sec. 188.

Section 272. Buildings Converted or Altered.

1. A building not a tenement house, if converted or altered to such use, shall thereupon become subject to all the provisions of this Code affecting tenement houses hereafter erected.

2. No tenement house shall at any time be altered so as to be in violation of any provision of this Code. If any tenement house or any part thereof is occupied by more families than provided in this ordinance, or is erected, altered or occupied contrary to law, such tenement house shall be considered an unlawful structure, and the Superintendent may cause such building to be vacated. Such building shall not again be occupied until it or its occupation, as the case may be, conforms to the law.

Section 273. Certificate of Compliance. No building constructed as or altered into a tenement house shall be occupied in whole or in part for human habitation until the issuance of a certificate by the Superintendent that said building conforms in all respects to the requirements of this ordinance. Such certificate shall be issued within ten days after written application therefor, provided said building at the date of such application shall be entitled thereto. Such a certificate, or the record in the Department of Buildings that such a certificate has been issued by the head of such department may be relied upon by every person who in good faith purchases a tenement house or who in good faith lends money upon the security of mortgage covering a tenement house. Whenever any person has so relied upon such certificate, no claim that such tenement house does not conform in all respects to the provisions of this ordinance shall be made against such person or against the interest of such person in a tenement house to which such a certificate applies or concerning which such a statement has been issued.

Section 274. Unlawful Occupation. If any building constructed as or altered into a tenement house be occupied in whole or in part for human habitation in violation of Section 273, during such unlawful occupation any bond or note secured by a mortgage upon said building, or the lot upon which it stands, may be declared due at the option of the mortgagee. No rent shall be recoverable by the owner or lessee of such premises for said period, and no action or special proceeding shall be maintained therefor, or for possession of said premises for non-payment of such rent. The department of water supply shall not permit water to be furnished in any such tenement house, and said premises shall be considered unfit for human habitation, and the department shall cause them to be vacated accordingly. Provided, however, that any tenement house which has been occupied for human habitation for two years immediately preceding the adoption of this ordinance, in which no changes or alterations have been made except in compliance with this ordinance, shall be permitted to be occupied in the same manner as if a certificate had been issued that such tenement house conforms in all respects to the require-

ments of this ordinance, unless an action or proceeding to require it to be vacated shall have been brought within six months after the passage of this ordinance.

Section 275. Registry of Owner's or Lessee's Name.

Every owner of a tenement house and every lessee of the whole house, or other person having control of a tenement house, shall file in the Department of Buildings a notice containing his name and address; also a description of the property, by street number or otherwise, in such manner as will enable the department to easily find the same; also the number of apartments in each house, the number of rooms in each apartment, and the number of families occupying the apartments. In case of a transfer of any tenement house, it shall be the duty of the grantor or grantee of said tenement house to file in the Department within thirty days after such transfer, a notice of such transfer, stating the name of the new owner. In case of the devolution of said property by will, it shall be the duty of the executor and the devisee, if more than twenty-one years of age, and in case of the devolution of such property by inheritance without a will, it shall be the duty of the heirs, or in case all of the heirs are under age, it shall be the duty of the guardians of such heirs, and in case said heirs have no guardians, it shall be the duty of the administrator of the deceased owner of said property to file in said department a notice, stating the death of the deceased owner, and the names of those who have succeeded to his interest in said property, within thirty days after the death of the decedent, in case he died intestate, and within thirty days after the probate of his will, if he died testate.

Section 276. Light and Ventilation.

1. *Percentage of Lot Occupied.* No tenement house shall occupy, either alone or with other buildings, except as otherwise provided in the sections prescribing the measurements for yards and courts, a greater percentage of the area of the lot than as follows:

- (a) In the case of a corner lot not more than 90 per cent.
- (b) In the case of an interior lot which exceeds 90 feet in depth and does not exceed 105 feet in depth, not more than 70 per cent.

(c) In the case of an interior lot which exceeds 105 feet in depth, not more than 65 per cent;

2. The space occupied by outside exit stairways shall not be considered a part of the lot occupied. For the purposes of this section the measurements shall be taken at the ground level, except that where such a building has no basement, and the cellar ceiling is not more than 2 feet above the curb level, the measurements may be taken at the level of the second tier of beams. The provisions of this section shall not apply to a tenement house running through from one street to another street, provided that the lot on which it is situated does not exceed 100 feet in depth.

*Percentage of lot occupied by existing tenements,
Sec. 303, par. 1.*

Section 277. Height, and Pent Houses.

1. The height of a tenement house shall not exceed one and one-half times the width of the widest street upon which it stands and in no case exceed 125 feet. Pergolas or similar open ornamental treatment of roof gardens or playgrounds shall not be considered as affecting such height.

2. If there are pent houses or superstructures, other than bulkheads, exceeding 10 feet in height or covering an aggregate area greater than 10 per cent. of the area of the roof, the height measurement shall be taken to the top of the highest of such pent houses or superstructures.

3. A pent house, erected on the roof of a fireproof tenement house in which one or more passenger elevators are operated, shall not be considered as affecting the height measurement of the building, provided the pent house complies with the following requirements:

(a) The pent house, including all the bulkheads, shall not cover more than 50 per cent. of the area of the main roof.

(b) The pent house shall be set back at least 10 feet from both the front and rear walls of the building, and at least 3 feet from any court wall, and shall have a clear inside height of not less than 9 feet from finished floor to finished ceiling, and shall not exceed 12 feet in height from the highest point of the main roof to the highest point of the pent house roof.

- (c) The pent house shall be entirely of fireproof construction.
- (d) The pent house shall not be used or rented as apartments but its use shall be limited solely to laundry and store room purposes, and to servants' and janitors' quarters.

Section 278. Yards.

1. Behind every tenement house there shall be a yard extending across the entire width of the lot. Except upon a corner lot, such yard shall have an unobstructed opening from every point to the sky, except that an unenclosed outside stairway, serving as a fire-escape exit, or a bridge or platform not exceeding 4 feet in width, may extend above the yard from the roof of a tenement house to the roof of an adjoining or abutting building, without prejudice to this requirement.

2. The depth of said yard, measured from the extreme rear wall of the house to the rear line of the lot, shall be as follows:

- (a) Except upon a corner lot, the depth of the yard behind every tenement house not exceeding 36 feet in height shall be not less than 10 feet. Said yard shall be increased in depth one foot for every additional 12 feet in height of the building, or fraction thereof.
- (b) The depth of the yard behind every tenement house upon a corner lot shall be not less than 10 per cent of the depth of the lot, but not less than 10 feet.
- (c) Where a tenement house on a corner lot has no basement, and the cellar ceiling is not more than 2 feet above the curb level, the yard may start at the level of the second tier beams.
- (d) Where a corner lot is more than 50 feet in width, the yard for that portion in excess of 50 feet shall conform to the provisions of paragraph (a).

In the case of a gore shaped corner lot, where the width at the rear line is greater than the width at the front and the average width of the lot does not exceed 50 feet, the width through the center shall be taken for the purpose of determining the dimensions of the yard.

- (e) For tenement houses upon a lot which runs from one street to another, and the depth of which exceeds 105 feet, there shall be a yard space through the lot midway between the two streets and extending across the full width of the lot.

The depth of said yard space measured from wall to wall shall be not less than 12 feet for tenements not exceeding 36 feet in height, and shall be increased 1 foot for every additional 12 feet in height or fraction thereof. Where such building has no basement, and the cellar ceiling is not more than 2 feet above the curb level, such yard space may start at the level of the second tier of beams.

- (f) When a fireproof tenement house extends from street to street, the two portions of the building may be connected and the yard between such portions built upon, but not above the level of the second tier of beams, nor so as to convert any unoccupied portion of such yard into a court less in size than the minimum size hereinafter prescribed.
- (g) Where a single tenement house runs through from street to street, and also occupies the entire block, no yard need be provided.
- (h) When a single tenement house is situated on a lot formed by the intersection of two streets at an acute angle, the yard of the said house need not extend across the entire width of the lot, provided that it extends to a point in line with the middle line of the block.

*Yards for existing tenements enlarged or altered,
Sec. 303, par. 2.*

Section 279. Courts. No court of a tenement house shall be covered by a roof or skylight, but every such court shall be at every point open from the ground to the sky unobstructed, except by an outside exit stairway.

Section 280. Outer Courts.

1. Where one side of an outer court is situated on the lot line, the width of the said court, measured from the lot line to the opposite wall of the building, for tenement houses not exceeding 60 feet in height, shall be not less than 6 feet in any part; for every 12 feet of increase or

fraction thereof in height of the said building, such width shall be increased 6 inches throughout the entire height of said court.

Wherever an outer court exceeds 65 feet in length, and does not extend from the street to the yard, the entire court shall be increased in width 1 foot for every additional 30 feet or fraction thereof in excess of 65 feet. But such measurement shall not prohibit one offset having a length not exceeding its width.

2. In tenement houses not exceeding four stories and cellar in height and which are arranged to be occupied by not more than eight families, exclusive of the janitor's family, or by more than two families on any floor, and in which each apartment extends through from the street to the yard, the width of an outer court situated on the lot line shall be not less than 4 feet in any part, provided that the length of such outer court does not exceed 36 feet.

3. In tenement houses not exceeding five stories and cellar in height, and which are not arranged to be occupied by more than ten families, exclusive of the janitor's family, or by more than two families on any floor, and in which each apartment extends through from the street to the yard, and in which the yard is not less than 15 feet in depth, the width of an outer court situated on the lot line shall be not less than 5 feet in any part measured to the lot line nor less than 10 feet measured to the nearest opposite wall, and provided further that the length of such outer court does not exceed 50 feet.

4. Where an outer court is situated between wings or parts of the same building, or between different buildings on the same lot, the width of the said court, measured from wall to wall, for tenement houses 60 feet in height shall not be less than 12 feet in any part; and for every 12 feet of increase or fraction thereof in the height of the said building such width shall be increased 1 foot throughout the entire height of the said court; and for every 12 feet of decrease in the height of the said building below 60 feet, such width of the said court may be decreased 1 foot. Wherever an outer court exceeds 65 feet in length, the entire court shall be increased in width 2 feet for every additional 30 feet or fraction thereof in excess of 65 feet.

5. In tenement houses not exceeding four stories and cellar in height and which are not occupied or arranged to be occupied by more than eight families in all, exclusive of the janitor's family, or by more than two families on any floor, and in which each apartment extends through from the street to the yard, the width of an outer court situated between wings or parts of the same building, or between different buildings on the same lot, measured from wall to wall, shall be not less than 8 feet in any part, provided that the length of said outer court does not exceed 36 feet.

6. In tenement houses not exceeding five stories and cellar in height and which are not occupied or arranged to be occupied by more than ten families in all, exclusive of the janitor's family, or by more than two families on any floor, and in which each apartment extends through from the street to the yard, and in which the yard is not less than 15 feet in depth, the width of an outer court between wings or parts of the same building, or between different buildings on the same lot, measured from wall to wall, shall be not less than 10 feet in any part, provided that the length of such outer court does not exceed 50 feet.

7. Wherever an outer court changes its initial horizontal direction, or wherever any part of such court extends in a direction so as not to receive direct light from the street or yard, the length of such portion of said court shall never exceed the width of said portion; such length to be measured from the point at which the change of direction commences.

8. Wherever an outer court is less in depth than the minimum width prescribed by this article, then its width may be equal to, but not less than its depth, provided that such width is never less than 4 feet in the clear. This exception shall also apply to each offset or recess in outer courts. No window except windows of water-closet compartments, bathrooms or halls, shall open upon any offset or recess less than 6 feet in width.

Section 281. Inner Courts.

1. Where one side of an inner court is situated on the lot line, the width of the said court measured from the lot line to the opposite wall of the building, for tenement

houses 60 feet in height shall be not less than 12 feet in any part, and its other horizontal dimension shall be not less than 24 feet in any part; and for every 12 feet of increase or fraction thereof in the height of the said building, such width shall be increased 6 inches throughout the entire height of said court, and the other horizontal dimension shall be increased 1 foot throughout the entire height of said court; and for every 12 feet of decrease in the height of the said building below 60 feet, such width may be decreased 6 inches and the other horizontal dimension may be decreased 1 foot.

2. In tenement houses not exceeding four stories and cellar or 55 feet in height, and which are not occupied or arranged to be occupied by more than eight families in all, exclusive of the janitor's family, or by more than two families on any floor, and in which each apartment extends through from the street to the yard, and which do not occupy more than 72 per cent. of the lot, in the case of an interior lot, the width of an inner court situated on the lot line measured from the lot line to the opposite wall of the building shall be not less than 8 feet in any part, and its other horizontal dimension shall be not less than 14 feet in any part.

3. In tenement houses which do not exceed three stories and cellar or 40 feet, in height, and which are not occupied, or arranged to be occupied, by more than six families in all, exclusive of the janitor's family, or by more than two families on any floor, a portion of such inner court may be occupied by a bath-room extension, provided that such extension has no window facing an opposite building, and that it does not occupy a portion of such court greater than $4\frac{1}{2}$ feet in width or 7 feet in length, and that between such extension and the lot line the court is never less than $3\frac{1}{2}$ feet in width. In such last named tenement houses which do not occupy more than 65 per cent. of the lot, in the case of an interior lot, where an inner court for its entire length immediately adjoins an existing inner court or equal or greater in size in an adjoining building or adjoins such a court in an adjoining building actually in course of construction at the same time, the width of such inner court measured from the lot line to the opposite wall of the build-

ing shall be not less than 4 feet in any part, and not less than 8 feet from wall to wall; and its other horizontal dimension shall be not less than $12\frac{1}{2}$ feet.

4. Where an inner court is not situated upon the lot line, but is inclosed on all four sides, the least horizontal dimension of the said court for tenement houses 60 feet in height shall be not less than 24 feet; and for every 12 feet of increase or fraction thereof in the height of the said building, the said court shall be increased 1 foot in each horizontal dimension throughout the entire height of said court; and for every 12 feet of decrease in the height of the said building below 60 feet, the horizontal dimensions of the said court may be decreased 1 foot in each direction.

5. In tenement houses not exceeding four stories and cellar in height, and which are not occupied or arranged to be occupied by more than eight families in all, exclusive of the janitor's family, or by more than two families on any floor, and in which each apartment extends through from the street to the yard, and which do not occupy more than 72 per cent. of the lot in the case of an interior lot, the least horizontal dimension of an inner court not situated on the lot line, but inclosed on all four sides, shall be not less than 14 feet.

6. In such tenement houses which do not exceed three stories and cellar in height and which are not occupied, or arranged to be occupied, by more than six families in all, exclusive of the janitor's family, or by more than two families on any floor, and which do not occupy more than 65 per cent. of the lot, in the case of an interior lot, the width of such inner court shall be not less than 8 feet in any part, and its other horizontal dimension shall be not less than $12\frac{1}{2}$ feet.

7. In inner courts which are not less than 10 feet wide in any part, offsets and recesses may be permitted, but where the depth of such offset or recess is less than the minimum width prescribed, then the width of said offset or recess may be equal to, but not less than its depth, provided that such width is never less than 4 feet in the clear. And no window except windows of water-closet compartments, bath-rooms or hallways shall open upon any offset or recess less than 6 feet in width.

8. Every inner court shall be provided with one or more horizontal intakes at the bottom. Such intakes shall always communicate directly with the street or yard, and shall consist of a passageway not less than 3 feet wide and 7 feet high which shall be left open; or if not open there shall always be provided in said passageway open grilles or transoms of a size not less than 5 square feet each, and such open grilles or transoms shall never be covered over by glass or in any other way. There shall be at least two such grilles or transoms in each such passageway, one at the inner court and the other at the street or yard, as the case may be.

Section 282. Outer and Inner Courts.

1. Outer and inner courts may be reduced by cutting off the corners of said courts, provided that the running length of the wall at the angle of the court does not exceed 7 feet.

2. In outer or inner courts of a less size than the minimum prescribed for tenement houses 60 feet in height, the running length of the wall containing windows in the angles of said courts shall not exceed 4 feet.

3. Where an inner court is less than 8 feet in width, measured from the lot line to the opposite wall of the building, said court shall not be reduced by cutting off the corners.

4. When a tenement house exceeding three stories in height has no basement and the cellar ceiling is not more than 2 feet above the curb level, the outer and inner courts may start at the level of the second tier of beams.

5. Where an inner court starts at the second tier of beams, unless the bottom of the court is at that level and an intake is there provided as prescribed by Section 281, paragraph 8, a portion of such court shall be left unbuilt upon, and shall communicate directly with the intake required by said section. Where one side of such court is situated on the lot line, the portion not built upon shall have a minimum width and length equal to the minimum width of the court; where such court is not situated upon the lot line, the unbuilt upon portion shall have one dimension equal to the minimum width of the court and the other dimension shall be not less than one-half that width.

6. Where a court starts at the level of the second tier of beams in whole or in part, and the bottom of said court is a skylight, proper access to the top of said skylight shall be provided. and said skylight shall be so arranged as to be easily cleaned.

Section 283. Building on Same Lot with Tenement House.

1. No separate tenement house shall be erected upon the rear of a lot 50 feet or less in width where there is a tenement house on the front of the said lot, nor upon the front of any such lot upon the rear of which there is such a tenement house.

2. If any building is placed on the same lot with a tenement house there shall always be maintained between the said building an open unoccupied space extending upwards from the ground and across the entire width of the lot; where either building is 60 feet in height such open space shall be 24 feet from wall to wall; and for every 12 feet of increase or fraction thereof in the height of such building, such open space shall be increased 1 foot in depth throughout its entire width, and for every 12 feet of decrease in the height of such building below 60 feet, the depth of such open space may be decreased 1 foot.

3. No building of any kind shall be so placed upon the same lot with a tenement house as to decrease the minimum size of courts or yards as hereinbefore prescribed.

4. If any tenement house is erected upon any lot upon which there is already another building, it shall comply with all of the provisions of this ordinance, and in addition the space between the said building and the said tenement house shall be of such size and arranged in such manner as is prescribed in this section, the height of the highest building on the lot to regulate the dimensions.

Section 284. Public Hallways, Width of.

1. Every entrance hallway shall be at least 4 feet wide in the clear, from the main entrance to the stairway enclosure. If such entrance hallway is the only entrance to more than one stairway, that portion of said hallway between the entrance and the first stairway shall be increased in width one-half for each additional stairway it serves.

2. In all tenement houses, public hallways serving as means of egress for not more than three apartments on one floor shall be 44 inches wide in the clear; and for every additional apartment so served on such floor the width shall be increased 8 inches.

3. For doorways serving such hallways, see Section 44, paragraph 3.

Section 285. Public Hallways, Construction of.

1. All stair hallways and hallways connecting with elevator shafts in tenement houses shall be enclosed and constructed as specified in Section 115; such partitions in non-fireproof tenements shall be constructed as required in Section 116. There shall be no wood or other inflammable material of any kind in such hallways. The floors of all such hallways shall be of fireproof construction. No wooden flooring or sleepers shall be permitted.

2. There shall be no transom or sash opening of any kind from such stair hallway to any other part of the house.

Section 286. Stairways.

1. In every tenement house all stairways shall extend from the entrance floor to the roof, and the stairs shall be at least 44 inches wide in the clear. Each apartment in every story shall have direct access to such stairways.

2. Each stairway shall have an exit to the street at the street level, or to a court or yard which connects directly with the street.

3. In non-fireproof tenement houses no closet of any kind shall be constructed under any stairway leading from the entrance story to the upper stories, but such space shall be left entirely open and free from incumbrance.

Construction of stairs, Sec. 289.

Construction of stairway and elevator shafts, Sec. 300.

Section 287. Stairways, Number of. Every tenement house containing not more than twenty apartments or

suites of rooms above the entrance floor shall have at least one interior stairway, and for every additional twenty apartments or fraction thereof, one additional stairway shall be provided. If such house contains not more than thirty apartments above the entrance floor, in lieu of an additional stairway, the entrance hallway and stair hallway may each be made one-half wider than specified in Section 284.

Number of exits required, Sec. 295.

Section 288. Cellar and Basement Stairways.

1. In tenement houses, cellar and basement stairways may be located inside the building, but shall not be located underneath the stairs leading to upper stories; this prohibition shall not apply where the basement is the main entrance floor of the house.

2. In every tenement house there shall be an outside entrance to the cellar or other lowest story.

Section 289. Stairs, Construction of. All stairs for tenement houses shall be constructed in accordance with the requirements of Section 45.

Section 290. Lighting of Public Hallways.

1. In every tenement house which is occupied, or arranged to be occupied by more than two families on any floor, or which exceeds four stories and cellar in height, every public hallway shall have at least one window opening directly upon the street or upon a yard or court. Such window shall be at the end of said hallway, with the natural direction of the light parallel to the axis of said hallway; if the hallway exceeds 60 feet in length there shall be one additional window in each additional 30 feet of hallway or fraction thereof. If the window is not thus located at the end of the hallway, there shall be at least one window opening directly upon the street or upon a yard or court in every 20 feet in length or fraction thereof of said hallway; but the foregoing provisions shall not apply to that portion of the entrance hallway between the entrance and the first flight of stairs, provided that the entrance door contains not less than 5 square feet of glazed surface. In every public hallway in such tenement house, recesses or returns, the

length of which does not exceed twice the width, may be permitted without an additional window. But wherever the length of such recess or return exceeds twice its width, the above provisions in reference to one window in every 20 feet of hallway shall apply.

2. At least one of the windows provided to light each public hallway or part thereof shall be at least $2\frac{1}{2}$ feet wide and 5 feet high, measured between stop-beads.

3. In every tenement house the aggregate area of windows to light or ventilate stair hallways shall be at least 18 square feet for each floor. There shall be provided for each story at least one of said windows, which shall be at least $2\frac{1}{2}$ feet wide and 5 feet high, measured between the stop-beads; except that a stair hallway window which opens on the street may be 4 feet high. On the top story a ventilating skylight will be accepted in lieu of a window for that story. A sash door shall be considered the equivalent of a window in this section, provided that such door contains the amount of glazed surface prescribed for such windows.

4. In a fireproof tenement house in which one or more passenger elevators are provided, elevator vestibules or hallways not less than 5 feet in minimum dimension and not exceeding in any dimension twice the width of the elevator shafts which they serve, may be permitted without a window to the outer air as required by paragraphs 1 and 2, provided such elevator vestibules are completely shut off from all other parts of the house by approved fireproof enclosures; and provided that such elevator vestibules are ventilated to the outer air by means of vent flues not less than 12 inches square; and provided that such elevator vestibules are equipped with wires, pipes and fixtures for both gas and electric lighting, and are kept properly lighted by electric light.

5. Any part of a hallway which is shut off from any other part of said hallway by a door or doors shall be considered a separate hallway within the meaning of this section.

6. In tenement houses which are not occupied or arranged to be occupied by more than two families on any floor, and which do not exceed four stories and cel-

lar in height, in lieu of a window opening directly to the outer air as above provided there shall be a stair-well not less than 12 inches wide extending from the entrance floor to the roof. In such last named tenement houses the entrance door shall contain not less than 5 square feet of glazed surface, and all doors leading from the public hallways shall be provided with translucent glass panels of an area not less than 5 square feet for each door, and with fixed transoms of translucent glass over each door.

7. In every tenement house a proper light shall be kept burning by the owner in the public hallways near the stairs upon the entrance floor, and upon the second floor above the entrance floor, every night from sunset to sunrise throughout the year; also upon all other floors from sunset until ten o'clock in the evening. This paragraph shall apply to existing tenements as well as those hereafter erected.

Section 291. Skylights for Public Hallways.

In every tenement house there shall be placed in the roof, directly over each stair-shaft, a ventilating skylight provided with ridge ventilators having a minimum opening of 40 square inches, or such skylight shall be provided with fixed or movable louvres; the glazed roof of such skylights shall not be less than 20 square feet in area. In existing tenement houses where the stairs and public hallways are not provided with windows on each floor, opening directly to the outer air, the skylights shall be provided with both ridge ventilators and with fixed or movable louvres or movable sashes.

Section 292. Lighting and Ventilation of Rooms.

1. In every tenement house every room, including water-closet compartments and bath-rooms, shall have at least one window opening directly upon the street or upon a yard or court of the dimensions hereinbefore specified; and such window shall be so located as to properly light all portions of such rooms. In addition to the above requirement, no apartment of three rooms or less shall extend in depth from the street or yard, as the case may be, for a greater distance than 18 feet without the intervention of an

inner or outer court adjoining said room, constructed as required by this ordinance.

2. Wherever a room in a tenement house opens upon an inner court less than 10 feet wide, measured from the lot line to the opposite wall of the building, such room shall be provided with a sash window, communicating with another room in the same apartment, such window to contain not less than 10 square feet of glazed surface, and arranged to open easily.

3. The total window area in each room, except water-closet compartments and bath-rooms, shall be at least one-tenth of the superficial area of the room, and the top of at least one window shall not be less than 7 feet 6 inches above the floor; and the upper half of it shall be made to open the full width. No such window shall be less than 12 square feet in area between the stop-beads. Transom or partition sash to private hallways or to adjoining rooms shall be provided to secure thorough ventilation, when required by the Superintendent; but no such transom or sash window shall be required in rooms containing two windows, provided each window contains 12 square feet of area between stop-beads, or in the case of a mullioned window containing 24 square feet.

4. No tenement house shall be so altered that any room, or public hallway or stairs, shall have its light or ventilation diminished in any way not approved by the Superintendent.

Lighting and ventilation of rooms in existing tenements, Sec. 303, par. 4 and 5.

Section 293. Lighting of Alcove Rooms. An alcove in any room in a tenement house shall be separately lighted and ventilated as required in Section 292. No part of any room in a tenement house shall be enclosed or subdivided at any time, wholly or in part, by a curtain, portiere, partition or other contrivance or device, unless such isolated part of the room shall contain a window as above required, and has a floor area of not less than 70 square feet.

Section 294. Size of Rooms. In every tenement house all rooms, except water-closet compartments and

bath-rooms, shall be of the following minimum sizes: In each apartment there shall be at least one room containing not less than 120 square feet of floor area, and each other room shall contain at least 70 square feet of floor area. No room shall be less than 9 feet high from the finished floor to the finished ceiling, nor less than 7 feet wide in its least horizontal dimension for an area of 70 square feet; except that in a fireproof tenement house in which one or more power passenger elevators are operated, servants' bedrooms may be not less than 6 feet in their least horizontal dimension.

Section 295. Exits Required.

1. In all tenement houses every apartment or suite of rooms above the entrance floor shall have at least two independent means of egress located remote from each other and extending continuously to the street, or to a court or yard connected with the street, so arranged that each may be reached from the same apartment without having to pass the other. One of such means of egress shall be an interior stairway constructed and arranged as specified in Sections 284 to 289 inclusive. The other may be an additional interior stairway constructed the same as the first, or a smokeproof tower, an outside exit stairway, or a horizontal exit, as specified in Sections 45 to 47 inclusive.

2. The second means of exit shall be so located and arranged as to connect directly to at least one room or private hallway in each story above the first. Such room or private hallway shall be accessible to every room of the apartment without passing through a public hallway. The connection shall not be made through a bathroom or water-closet compartment. Access to exits shall not be obstructed in any manner.

Section 296. Partitions in Non-Fireproof Tenements.

Apartment partitions in non-fireproof tenement houses shall be constructed as specified in Section 116.

Apartment partitions within the meaning of this section are partitions crossing the floor beams at any angle, and de-

signed to separate apartment from apartment, or any part of an apartment from the public hallway or other public part of the building.

Partitions in non-fireproof buildings used for business and residence, Sec. 98.

Allowable areas for tenements, Sec. 38, par. 2 and 3.

Section 297. Bulkheads. Every interior stairway shall be enclosed with a bulkhead at the level of the roof, provided with a fire door opening outward. In non-fireproof tenements such bulkheads may be constructed of wood studs filled with fireproof material and covered with metal on the outside and wire lath and plaster on the inside. No bulkhead door shall be locked from the inside, but may be fastened by movable bolts or hooks.

Pent houses on tenements, Sec. 277.

Section 298. Chimneys, Fireplaces and Flues. In tenement houses every apartment shall be provided with an open fireplace or grate or a stove pipe connection with a flue or chimney. Under no circumstances shall a gas stove be directly connected with a flue that communicates with another apartment.

Construction of chimney flues, Sec. 178.

Section 299 Vent Flues. In a fireproof tenement house water-closets and bathrooms which are supplementary to those required by law may be ventilated by individual vent flues extending independently of any other flue, to and above the roof. Such vent flues shall not be covered at the top, but may be provided with a hood or louvres. Such vent flues shall not be located against an outside wall, and shall be not less than 3 square feet in area.

Construction of vent shafts, Secs. 90-93 and 184.

Section 300. Shafts. All shafts in tenement houses shall be constructed as provided in Sections 90-93.

Construction of light and vent shafts in existing tenements, Sec. 303, par. 5.

Construction of dumbwaiter shaft in bakery in a tenement, Sec. 305.

Section 301. Frame Tenement and Tenements Prohibited on Lot with Frame Buildings.

1. No existing frame tenement house within the fire limits shall be enlarged or raised, except as provided in Section 186.

2. Frame tenements are prohibited. For limitations on frame dwellings outside the fire limits see Section 188.

NOTE.—Frame tenements are prohibited because the number of families that may occupy a frame building is limited to two, and since by definition (Sec. 270) a tenement house is one occupied by three or more families, it follows that the two-family frame house is not a tenement.

3. Within the fire limits no tenement house shall be placed or built upon the same lot with a frame building.

Construction of frame buildings, Secs. 188-192.

Section 302. Storage of Dangerous or Combustible Materials Prohibited in Tenements. No part of any tenement house, nor of the lot upon which it is situated, shall be used as a place of storage, or handling of any article dangerous or detrimental to life or health, nor for the storage or handling of feed, hay, straw, excelsior, lumber, cotton, paper, feathers, rags or other inflammable material. This section applies to existing tenements and those hereafter erected.

Section 303. Tenement Houses Enlarged or Altered.

1. No tenement house shall be enlarged, or its lot be diminished, so that a greater percentage of the lot shall be occupied by buildings or structures than is permitted in Section 276, provided that the space occupied by outside exit stairways, and by chimneys or flues located in yards and attached to the houses and which do not exceed 5 square feet in area and do not obstruct light or ventilation, shall not be considered a part of the lot occupied.

2. No tenement house shall be enlarged or its lot diminished, so that the yard shall be less in depth than the minimum depths prescribed in Section 278. The measurements in all cases shall be taken from the extreme rear wall of the building to the rear lot line, and across the full width of the lot, and such yard shall be at every point

open from the ground to the sky, except as provided in this section and in Section 278, paragraph 1.

3. Any additional room constructed in a tenement house shall comply in all respects with the provisions of this ordinance except that such room may be of the same height as the other rooms on the same story of the house.

4. No room in a tenement house erected prior to the adoption of this ordinance shall be occupied for living purposes unless it shall have a window opening directly upon the street, or upon a yard not less than 4 feet deep, or above the roof of an adjoining building, or upon a court or shaft of not less than 20 square feet in area, open to the sky, without roof or skylight, unless such room is located on the top floor and is adequately lighted and ventilated by a skylight opening directly to the outer air.

5. Any shaft hereafter constructed in an existing tenement house, for lighting or ventilating rooms used for living purposes, shall be not less than 25 square feet in area, nor less than 4 feet wide in any part, and such shaft shall under no circumstances be roofed or covered at the top with a roof or skylight; every such shaft shall be provided at the bottom with a horizontal intake or duct, of a size not less than 4 square feet, and communicating directly with the street or yard; such duct shall be so arranged as to be easily cleaned out. Such shafts shall be of fire-resistive construction as provided in Sections 90-93.

Section 304. Privacy. In every apartment of three or more rooms in a tenement house, access to every living room and bedroom and to at least one water-closet compartment shall be had without passing through any bedroom.

Section 305. Dangerous Business. No bakery or place of business in which fat is boiled shall be maintained in any tenement house which is not fireproof throughout, unless the ceiling, sidewalls, and all exposed iron or wooden girders or columns within the said bakery or within said place where fat boiling is done, are made safe by fireproof materials around the same. There shall be

no openings either by door or window, dumb-waiter shafts or otherwise, between said bakery or other parts of the building; except that in bakeries in which no fat is boiled, and in which no apparatus for fat boiling is present, a dumbwaiter communicating between the place where the baking is done and the store above may be maintained, if entirely inclosed in a brick shaft with walls not less than 8 inches thick, without any openings whatever except one door opening in the bake-shop and one door opening in the bakery store; such openings shall each be provided with a fire door so arranged that when one door is open or partly open, the other door shall be entirely closed.

Storage rooms for paint, oils, etc., Sec. 89, par. 2.

Section 306. Structural Requirements. All structural details for tenement houses which are not specifically treated in this ordinance known as the "Tenement House Law" shall be subject to the requirements of the various sections of this Code dealing with such details, and the construction shall in every way conform to the provisions therein contained.

Section 307. Water Supply. In every tenement house there shall be in each apartment a proper sink with running water. The owner shall provide proper and suitable tanks, pumps or other appliances necessary to receive and distribute an adequate and sufficient supply of such water in each apartment, at all times of the year, during all hours of the day and night.

Section 308. Water-Closet Accommodations.

1. In every tenement house there shall be a separate water-closet in a separate compartment within each apartment. Every water-closet and bath hereafter installed in any tenement house shall be placed in a compartment completely separated from every other water-closet and bath; such compartment shall be inclosed with plastered partitions extending to the ceiling and shall have a window opening directly upon the street or yard, or upon a court of the dimensions herein before specified. Such compartment shall also be provided with proper means of lighting.

2. The floor of every water-closet compartment shall be made waterproof with asphalt, tile, stone or other approved material; such waterproofing shall extend up the walls at least 6 inches above the floor. No drip tray shall be permitted. No water-closet fixtures shall be inclosed with woodwork.

3. No water-closet shall be maintained in the cellar of any tenement house without a special permit in writing from the Superintendent.

Section 309. Plumbing. In every tenement house all plumbing pipes shall be exposed, when so required by the proper authorities. When plumbing or other pipes pass through floors or partitions, the openings around such pipes shall be sealed with plaster or other incombustible materials, to prevent the passage of air or the spread of fire from one floor to another, or from room to room.

Section 310. Cellars.

1. In tenement houses all walls below the ground level and the cellar or lowest floor shall be made dampproof. The entire cellar or lowest floor shall also be covered with a bed of good concrete at least 4 inches thick, troweled to an even surface. All cellars shall be properly lighted and ventilated.

2. In tenement houses there shall be not more than one apartment in the cellar and this shall contain not more than five rooms and bath, and shall be occupied solely by the janitor and his family, and no other rooms in the cellar shall be occupied for living or sleeping purposes.

3. No room in the cellar shall be occupied for living purposes, unless all of the following conditions are complied with:

- (a) Such room shall be at least 9 feet high in the clear and its ceiling shall be in every part at least 4 feet above the curb level of the street in front of the building, when such room is located in the front part of the building; if such room is located in the rear of the building, the ceiling shall be not less than 2 feet above the curb level of the street in front of the building, and the yard or court upon which such room opens shall extend to a point 6 inches below the floor level of said room.

- (b) Every such room shall be an integral part of an apartment containing a room having a window opening directly to the street or yard.
- (c) There shall be appurtenant to such room the use of a separate water-closet.
- (d) Such room shall have a window opening upon the street, or upon a yard or court; and the area of the window shall be not less than 12 square feet between stop beads. The upper half of such window shall open by means of a vertically sliding pulley hung sash.

Cellar stairways, Sec. 288.

Section 311. Care of Walls and Ceilings. The cellar walls and ceiling of every tenement house, and the walls of all yard courts, inner courts, and shafts connected with tenement houses, unless built of light colored brick, stone, or concrete, shall be thoroughly whitewashed or painted a light color by the owner, and shall be so maintained.

Section 312. Shafts, Courts, Areas, and Yards.

1. In every tenement house the bottom of all shafts, courts, areas, and yards which extend to the basement for light or ventilation of living rooms, shall be 6 inches below the floor level of the part occupied. In every tenement house all shafts, courts, areas, and yards shall be properly concreted, graded, drained, and connected with the street sewer.

2. In every tenement house there shall be at the bottom of every shaft and inner court, a self-closing fire door giving sufficient access to such shaft or court to enable it to be properly cleaned.

Section 313. Roofs. The roof of every tenement house shall be maintained water-tight, and the rain water therefrom shall not be permitted to discharge into the yards or courts.

Section 314. Cleanliness.

1. No wall paper shall be placed upon a wall or ceiling of any tenement house unless all wall paper shall be first removed therefrom and said wall and ceiling thoroughly cleaned.

2. Every tenement house and every part thereof shall be kept clean and free from any accumulation of dirt, filth, or garbage or other matter in or on the same, or in the yards, courts, passages, areas or stair halls connected with or belonging to the same.

3. The owner of every tenement house shall provide suitable incombustible receptacles for ashes, rubbish, garbage, and all other refuse material.

Section 315. Prohibited Use. No horse, cow, calf, swine, sheep or goat shall be kept in a tenement house, or on the same lot or premises thereof; and no tenement house, or the lot or premises thereof shall be used for a stable.

PART XXXIX.

ADMINISTRATION OF DEPARTMENT OF BUILDINGS. •

Section 316. General Powers and Duties of the Superintendent of Building Construction.

1. The Superintendent of Building Construction shall be a competent architect, engineer, or builder of at least 10 years' practical experience. He shall have the power, and it shall be his duty to enforce the provisions of this Code; to approve or disapprove within a reasonable time, applications, plans, detail drawings, and amendments thereto; to issue permits, notices, and certificates; to make rules and specifications to assist in the proper application of this Code, or providing for necessary additional regulations covering details of special construction; to pass upon questions relative to the mode, manner of construction, or materials to be used in the erection or alteration of a building; to require that such mode, manner of construction, or materials, shall conform to the true intent and meaning of the several provisions of this Code; to authorize the City Attorney to institute any and all actions that may seem proper or necessary for the enforcement of its provisions.

2. The Superintendent shall have power to vary or modify any provision of this Code or of any existing law or ordinance relating to the construction, alteration or re-

removal of any building or structure erected or to be erected within his jurisdiction upon an application to him therefor in writing by the owner of such building or structure, or his duly authorized agent, where there are practical difficulties in the way of executing the strict letter of the law, so that the spirit of the law shall be observed and public safety secured and substantial justice done. Where such application has been filed with the Superintendent the owner of such building or structure or his duly authorized agent shall have the right to present a petition to the Superintendent, setting forth the grounds for the desired variation or modification, and requesting that he may appear before him and be heard. The Superintendent shall fix a date within a reasonable time for a hearing upon such application, and shall as soon as practicable render a decision thereon, which decision shall be final, except for appeal to the Board of Examiners as provided in Sec. 317. The particulars of each such application and of the decision thereon shall be entered upon the records of the Department of Buildings, and if the application is granted a certificate therefor, together with a statement of the reasons for such decision, shall be issued by the Superintendent. A record of all such modifications shall be kept at the Department of Buildings, properly indexed under section numbers of this Code, and shall be open to public inspection.

Any necessary modifications of this Code which may be made by the Superintendent under the provisions of this paragraph, or such rules and specifications as he may draft in accordance with the authority granted in paragraph 1, shall in no manner serve to essentially lower the standards of construction which this Code prescribes.

3. The Superintendent shall have power from time to time to amend or repeal rules and specifications which have been in force in the Department. No rules, specifications or changes therein shall become effective until they have been published in the _____ at least one day for each eight successive weeks, and an opportunity given for a public hearing on same. During the period of publication they shall be posted on the bulletin board in the public office of the Department of Buildings, and after publication and no-

tice of public hearing thereon, they shall automatically become operative, and have the same force and effect as any part of this Code. They shall be kept on record and shall be published in full in the first annual report following the date of their adoption.

4. The Superintendent shall establish specifications for all tests, also specifications for the quality of materials and appliances or methods of construction not otherwise covered by this Code. Such specifications shall give the details for the conduct of such tests and the necessary requirements to secure approval of same. They shall be filed in the office of the Superintendent and be published as soon thereafter as possible in the manner provided in paragraph 3 of this section. A public record of all approved material and construction shall be kept in the office of the Superintendent of Building Construction. Such record shall state by whom the approval is granted, and give a clear statement of the evidence upon which its fitness for approval was based.

5. During the month of January of each year, the Superintendent shall prepare a complete list of all materials, appliances or methods of construction which have passed the required tests prescribed by this Code, or have been approved by other rules of the Department, and the necessary information as to the conditions under which said materials, appliances or methods of construction were tested and approved. Said list shall be filed in the office of the Superintendent not later than the first week in February and be published in the manner provided in paragraph 2 of this section.

Definition of "approved," Sec. 7, par. 2.

6. No new materials, appliances, or methods of construction shall be employed in any building until they have met the test requirements of the Superintendent of Building Construction and been approved by him.

7. The Superintendent shall have the power to appoint a chief inspector, and such other inspectors or subordinates as may be provided for in the City Charter, and as in his judgment may be necessary to enforce the rules of the Department and the provisions of this Code. The chief inspector shall be a competent architect, engineer or builder

of at least ten years' practice. Other inspectors shall be competent men, either architects, engineers, or skilled artisans who shall have had at least five years' experience. It shall not be lawful for any officer or employee in the Department of Buildings to be engaged in business as an architect, engineer, carpenter, plumber, iron worker, mason or builder, while holding office in the Department, or to be engaged in the manufacture or sale of articles entering into the construction of buildings, or act as agent for sale of such articles.

8. The Superintendent shall have power to punish any employee, for neglect of duty, violation of rules, or disobedience, by forfeiting or withholding pay for a specified time. Subject to the requirements of the civil service law, the Superintendent shall have power to dismiss any subordinate appointed by him or by any predecessor in office from the service of the Department at any time.

9. Any officer or employee of the Department of Buildings who shall ask, solicit, accept, or receive any money or other compensation for enforcing or for modifying or changing any order or requirement of the Department shall be guilty of a felony.

10. The Department of Buildings shall have a seal, to be approved by the Mayor, and the use of such seal shall be as directed by the Superintendent.

11. The Superintendent shall prescribe uniform badges to be worn by him, his inspectors and other employees of the Department of Buildings. All officials and employees of the Department of Buildings, so far as it may be necessary for the performance of their respective duties, shall have the right to enter any building or premises in the city of upon exhibiting their badges.

12. Neither the Superintendent of Buildings nor any person appointed, hired or employed by him, when acting in good faith, and without malice, shall be liable for damages by reason of anything done under the provisions of this Code.

Section 317. Appeals.

1. Whenever the Superintendent of Building Construction shall reject or refuse to approve the mode or manner of

construction proposed to be followed, or materials to be used in the erection or alteration of any building or structure, or when it is claimed that the rules and specifications of the Department of Buildings, or the provisions of this Code do not apply, or that an equally good or more desirable form of construction can be employed in any specific case, the owner of such building or structure, or his duly authorized agent, may appeal from the decision of the Superintendent where the amount involved by such decision shall exceed the sum of one thousand dollars.

2. Such appeal shall be heard by a Board of Examiners consisting of the Chief of the Fire Department and four other members appointed annually by the Mayor, two of whom shall be practicing architects of at least ten years' practice, and two builders of at least fifteen years' experience. The said examiners shall each take the usual oath of office before entering upon the performance of their duties. The Mayor shall annually designate one of said examiners as the presiding officer of said board. At least four affirmative votes shall be necessary to the granting of any petition by said board. No member of said Board of Examiners shall pass upon any question in which he is personally interested. The said board shall meet once a week upon notice from the Superintendent. The members of said Board of Examiners shall be entitled to and shall receive ten dollars for each attendance at a meeting of said board, to be paid by the City Treasurer upon the voucher of the clerk of said board. The clerk of the board shall be appointed, and may be removed by the Mayor, and shall receive a salary of dollars per annum.

The appeal authorized by this section, may be taken within 10 days from the entry of a decision upon the records of the Department of Buildings, by filing with the clerk of the Board of Examiners an application on appropriate blanks furnished by the Board of Examiners, containing the decision of the Superintendent, the date of entry, the grounds upon which said appeal is taken, and the arguments in support of the request of a reversal of the decision of the Superintendent by the Board of Examiners.

The Board of Examiners shall thereafter fix a day within a reasonable time for the hearing of such appeal, and

upon such hearing the appellant may be represented either in person or by his agent or attorney. The decision of the Board of Examiners, upon such appeal, shall be rendered without unnecessary delay, and such decision shall be final.

PART XL.

VIOLATIONS, PENALTIES, AND COURTS HAVING JURISDICTION.

Section 318. Removal of Violations. Whenever the Superintendent of Building Construction has evidence that there exists in any building or structure erected or in course of erection or alteration a violation of any provision of this Code, or of any of the regulations of the Department of Buildings governing the installation or repair of any plumbing, drainage or electrical work, he may in his discretion, authorize the City Attorney to institute any appropriate action or proceeding at law or in equity, to restrain, correct, or remove such violation; prevent further work upon the building or structure; require its removal; or prevent the occupation or use of the building or structure.

Section 319. Notice of Violation and Service Thereof. Notices of violation of any provision of this Code shall be issued by the Superintendent and shall have his name affixed thereto. A Notice of Violation shall be served upon the person charged with the violation or upon the person designated in Section 323, or by any person authorized by said Superintendent. Such notice shall contain a brief statement of the nature of the violation charged and the penalty or penalties that may be incurred, a brief description of the building or structure and premises to which the notice refers, including its location and a direction to the owner requiring that the violation be removed forthwith. A copy of Section 324 entitled "Duty of Occupant to Notify Owner," shall be printed thereon. If the person charged with the violation, or the person designated in Section 323 cannot be found in the city of _____ after diligent search, then service may be made by affixing the same in a conspicuous place on the property as to which a violation is alleged to exist, or to which such notice may refer, and by

depositing in a post office in the city of _____ a copy thereof in a securely closed postpaid wrapper, addressed to him at his last known place of residence, or his last known place of business. If his place of residence or business is not known, and the Superintendent cannot with reasonable diligence ascertain either, or a place where he would probably receive matter transmitted through the post-office, he may dispense with the deposit of any papers, and upon an affidavit thereof the notice of violation shall be deemed served, and the same action or proceeding may be taken thereupon as if he had been personally served.

Section 320. Punishment for Violation of Provision of Code.

1. *Violation a Misdemeanor.* A person who shall construct, alter, remove or maintain a building or structure or any of its appurtenances in violation of any of the provisions of this Code shall be guilty of a misdemeanor, punishable by a fine of not less than two hundred and fifty dollars or by imprisonment not exceeding 60 days or by both fine and imprisonment. If such violation shall be removed or in process of removal within 10 days after the service of a notice of violation and shall be actually removed within a reasonable time, the liability for all or a portion of such penalty may cease, in the discretion of the court. Whenever it shall be necessary in the opinion of the Superintendent in order to carry out or enforce any of the provisions of this Code, he may and shall have authority to call on the Police Department for aid and assistance, and it shall be the duty of the Police Department, when called upon by the Superintendent, to co-operate with the said Superintendent in order to enforce or put into effect any of the provisions of this Code.

2. *Courts Having Jurisdiction for Enforcement of Penalties.* For the enforcement or recovery of a penalty, an action may be brought in the name of the city of _____ in any municipal court or court of record in said city, and no court shall lose jurisdiction of any action by reason of a plea that the title to real estate is involved, provided the object of the action is to recover a penalty for a violation. When any judgment shall be rendered therefor, the same shall be collected and enforced as judgments of the courts in which said action was commenced.

PART XLI.

PROCEEDINGS IN CONNECTION WITH UNSAFE
OR COLLAPSED BUILDINGS.

Section 321. Unsafe Buildings.

1. *Notice to Make Safe.* When it is reported to the Superintendent that any building or structure or part thereof is unsafe or dangerous, he shall immediately cause an examination of the property to be made. If this examination shows the building or structure or any portion thereof to be unsafe or dangerous, as to the construction, the occupancy or exits, the result thereof shall be entered upon a docket, and the Superintendent shall at once serve notice, in the manner prescribed in Section 319, upon the owner or upon the person designated in Section 323. Such notice shall have printed upon it a copy of Section 324 and shall contain a description of the building or structure considered unsafe or dangerous, and shall require the same to be made safe and secure or removed, as may be considered necessary by the Superintendent; and it shall require the person served therewith to immediately certify in writing to the Superintendent his consent or refusal to secure, make safe or remove the building or structure or part thereof. If he immediately certifies in writing his consent to comply therewith he shall be allowed 24 hours following the service of such notice in which to begin to secure, make safe or remove the building or structure. He shall employ sufficient labor and materials, and immediately begin to secure, make safe or remove the same. The work shall be done as speedily as possible, and shall be continuously prosecuted to the satisfaction of the Superintendent.

Application of owner to demolish a building, Sec. 6.

2. *Notice of Survey.* Should the person so served with notice neglect or refuse to comply with any of the requirements of said notice to the satisfaction of the Superintendent, a further notice, which shall have printed upon it a copy of Section 324, shall thereupon be served upon him in the manner heretofore prescribed. Said notice shall state that a survey of the premises specified therein will be made by a Committee of Surveyors, to be appointed as prescribed in Section 325, at a stated time and place, which time shall

be not less than 24 hours nor more than 3 days from the time of service of said notice. But if the owner proceeds to secure, make safe or remove the unsafe or dangerous building or structure, or part thereof, and prosecutes the work in a manner satisfactory to the Superintendent, the survey may be adjourned or cancelled at his discretion.

3. *Survey.* Should the Superintendent of Building Construction consider it necessary, a survey shall be held. The Committee of Surveyors shall attend at the time and place specified, examine the building or structure and immediately report in writing its opinion thereof to the Superintendent. Should two members of the committee report the building or structure unsafe or dangerous, a copy of their report, with a copy of the notice of survey, shall forthwith be posted in a conspicuous place upon the building or structure. A copy of their report shall also be immediately presented by the Superintendent to the City Attorney, who shall forthwith apply to the court for a Precept directed to the Superintendent, commanding him to remove the building or structure or part thereof, or make the same safe and secure.

A cause of action is hereby created for the benefit of the city of _____ against the owner of said building or structure and of the land upon which it is situated, for the amount of the fees, with interest, to the Committee of Surveyors, which action shall be prosecuted by the City Attorney in the name of the city of _____.

4. *Court Proceedings.* In any proceeding to remove an unsafe or dangerous building or structure or to make the same safe and secure, the written report of survey shall constitute the issue of fact. The said issue shall be brought to trial before a justice of the court, who shall give this issue precedence over every other business, and his decision shall be final. If the decision of the court be that the building or structure or part thereof is unsafe or dangerous, the justice shall immediately issue a Precept commanding the Superintendent to secure, make safe or remove the unsafe or dangerous building or structure or such part thereof as shall be specified, permitting him in his discretion to authorize the owner to do so, as hereinafter specified, and empowering him to modify the requirements of said

Precept when he shall be satisfied that such modification will secure equally well the safety of the building or structure.

5. *Execution of Precept.* The Superintendent shall thereupon proceed to execute the Precept as therein directed. He may procure the necessary materials, ways, works and means, and employ such experts, employees, mechanics, workmen, and laborers as may be necessary for that purpose; or may, in his discretion, upon payment by the owner of the unsafe or dangerous building or structure, of all costs and expenses theretofore incurred in the proceedings, issue to him an authorization to carry out the requirements of the Precept, and this work shall be immediately done to the satisfaction of the Superintendent. If thereafter in his judgment it shall be necessary, the Superintendent shall himself enter and execute said Precept, as heretofore prescribed. After completion of the work the Superintendent shall cause the return to the said court of said Precept, with an endorsement thereon of his action thereunder, and a statement of the costs and expenses thereby incurred, including preliminary searches and surveys.

6. *Costs; Disbursements; Expenses.* The justice shall thereupon tax, award, adjust and allow such costs, disbursements and expenses as may have been incurred and render judgment therefor, and direct that the same be paid by the owner of the property designated in the action, and may declare the same a lien upon said property and direct that it be sold as on a judgment in foreclosure of a mortgage upon real estate or a mechanic's lien upon real property. The subsequent proceedings shall be in the same manner and with like effect as under judgments in said forms of action; and in and about all preliminary proceedings, as well as the carrying into effect of any orders of the court or any Precept issued by any court, said Superintendent may make requisition upon the Treasurer of the city of for such amount or amounts of money as shall be necessary to meet the expenses thereof; and upon the same being approved by any judge or justice of the court from which the said order of Precept was issued and presented to said Treasurer, he shall pay the several amounts that may from time to time be required, which shall be reimbursed by the

payment of the amount and interest at 6 per cent. out of the judgment or judgments obtained as aforesaid, if the same shall be collected.

7. *Emergency Work.* If in the opinion of the Superintendent there shall be actual and immediate danger of the falling of any building or structure or part thereof so as to endanger life, limb or property, or there shall be any illegal or defective work, or work in violation of or not in compliance with any of the provisions or requirements of this Code, he or such person as he may authorize, shall order all further work to be stopped in and about said building or structure, and require all persons to vacate the same. He shall cause such work to be done as in his judgment may be necessary to remove the danger, and he may, when necessary for the public safety, temporarily close the sidewalks and streets adjacent to such building or structure. The Police Department of the city of _____, when called upon by the Superintendent of Building Construction, shall enforce such orders and requirements.

8. *Recovery of Bodies.* In case a building or structure or part thereof falls and persons are known or believed to be buried in the ruins, it shall be the duty of the Superintendent to cause a search of the premises to be made for rescue of the living and the recovery of the bodies of the dead. For such purpose he may temporarily hire persons, and temporarily hire or purchase the materials, ways, works and means which may be necessary. Whenever, in making such search, it shall be necessary to remove debris from the premises, it shall be the duty of the various departments of the city of _____, when called upon by the Superintendent of Building Construction, to co-operate, and to provide a suitable and convenient dumping place for the deposit of such debris. The Superintendent is hereby authorized and empowered in such cases to order and require the occupants of such building or structure or part thereof, to vacate the same forthwith, and he may, when necessary for the public safety, close the sidewalks and streets adjacent to such buildings or structures, or part thereof, and prohibit the use of the same; and the Police Department of the city of _____, when called upon by the Superintendent of Building Construction, shall enforce such orders or requirements.

PART XLII.

LEGAL PROCEEDINGS, REPRESENTATIVE
OF OWNER, COMMITTEE OF SURVEYORS.

Section 322. Legal Proceedings.

1. *Duty of City Attorney to Proceed.* Upon written request by the Superintendent of Building Construction the City Attorney shall sue for and collect all penalties and take charge of and conduct all legal proceedings imposed or provided for by this Code; and all suits or proceedings instituted for the enforcement of any of the several provisions of this Code or for the recovery of any penalty thereunder shall be brought in the name of the city of _____ by the City Attorney, to whom all notices of violation shall be returned for prosecution, and it shall be his duty to take charge of the prosecution of all such suits or proceedings, collect and receive all moneys that may be collected upon judgments, suits or proceedings so instituted, or which may be paid by any parties who have violated any of the provisions of this Code and upon settlement of judgment and removal of violations thereunder, execute satisfaction therefor.

2. *Temporary Injunctions.* In any action or proceeding for the enforcement of the provisions of this Code the city of _____ may apply to the Court for an order enjoining and restraining any violation, ordering the property vacated or prohibiting its use for any purpose whatsoever, until the hearing and determination of such action and the entry of final judgment therein.

3. *Undertaking Not Required.* No undertaking shall be required from the city of _____ or the Superintendent as a condition to granting an injunction or order, or by reason thereof, in any action or proceeding.

4. *Notice of Lis Pendens; Filing by Counsel.* Upon the commencement of an action or proceeding to enforce the provisions of this Code, the City Attorney shall file in the County Clerk's office of the County where the property is situated, a notice of lis pendens, stating the names of the persons claimed to be affected thereby, with a copy of the notice of violation or notice of survey, and proof of service

thereof, and a copy of the action or proceeding instituted or to be instituted. The City Attorney may, however, in his discretion, file such notice at any time.

5. *Effect of Notice of Lis Pendens.* A notice filed, as prescribed in the preceding paragraph, is constructive notice to an owner or encumbrancer of the property affected thereby, and to an owner or encumbrancer thereof, from or against a person with respect to whom the notice is to be filed and indexed, as prescribed in the next paragraph. A person whose conveyance or encumbrance is subsequently executed or subsequently recorded, is bound by all proceedings taken in the action, after filing of the notice, to the same extent as if he were a party to the action.

6. *Notice of Lis Pendens to be Filed and Indexed.* Each County Clerk with whom such notice is filed shall immediately file and index it to the name of the person specified in a direction appended at the foot of the notice of lis pendens and subscribed by the City Attorney, and to the property affected, and under the section number of the land map of the county where the property is situated.

7. *Cancellation of Notice of Lis Pendens.* After an action is commenced, and is settled, discontinued, abated or final judgment is rendered therein, against the city of _____ and the time to appeal therefrom has expired, or if the City Attorney unreasonably neglects to proceed with the action, the Court may, in its discretion, upon the application of any person aggrieved, and upon such notice as may be directed or approved by it, direct that the notice of lis pendens, filed as prescribed in the last paragraph, be cancelled of record by the County Clerk with whom it is filed. The cancellation shall be made by a note to that effect in the index to the names of each person and the property specified in the notice filed, referring to the order, or consent of counsel in this section provided, and a like note upon the notice filed. Unless the order is entered in the same clerk's office, a certified copy thereof shall be filed therein before the notice is cancelled.

8. Before or after an action is commenced to enforce a notice of violation, the notice of pendency thereof shall be likewise cancelled upon the written consent of the City Attorney, which consent shall be filed with and indexed by said County Clerk.

9. No officer of the Department of Buildings, acting in good faith and without malice, shall be liable for damages by reason of anything done in any such action or proceeding.

Section 323. Designation by an Owner of a Building. Either a resident or a non-resident of the city of _____, of full age, owning real estate or a building thereon, may execute and acknowledge in duplicate, a written designation of a resident of said city, as a person upon whom to serve a notice of violation, notice to make safe, or notice of survey, summons, a mandate, or any paper or process, under the provision of this Code, or either of the same, and may file the same, with the written consent of the person so designated, duly acknowledged; one in the office of the Superintendent, and one in the office of the County Clerk where the real estate or building or structure is situated. The designation must specify the residence and place of business of the person making it, and also of the person designated and the location of the property with respect to which the designation is made. It shall remain in force during the period specified therein, if any, or if no period is specified therein, until one year after the filing thereof, but it is revoked earlier, either by the death or legal incompetency of either of the parties, or by the filing of a revocation by either of the parties, duly acknowledged, and the consent of the Superintendent. The County Clerk must immediately file and index such designation, consent or revocation; and shall note, upon the original designation and index, the filing of a revocation. While the designation remains in force as prescribed in this section, a notice of violation, notice to make safe or notice of survey, a summons, a mandate, or any paper or process under the provisions of this Code, or either of the same, may be served upon the person so designated, in like manner and with like effect, as if it were served personally upon the person making the designation, notwithstanding his presence in the city of _____.

Section 324. Duty of Occupant to Notify Owner. Should a notice of violation, a notice to make safe, or a notice of survey be served upon an occupant of real estate or a building or structure, it shall be the duty of the person

upon whom such service is made, to give immediate notice thereof to the owner of said real estate or building or structure named in the notice, if such owner is within the city of _____ and his residence is known to such person; and if he is not within the said city, by depositing such notice in a post office in the city of _____ properly enclosed in a postpaid wrapper addressed to such owner at his then known place of residence.

Section 325. Committee of Surveyors.

1. A committee of surveyors shall consist of three persons, one of whom shall be the Superintendent of Building Construction or an Engineer, or an Inspector of the Bureau of Buildings designated in writing by said Superintendent; another of whom shall be an architect, civil engineer or builder of at least ten years' practice in the city of _____, appointed by the Mayor of said city; another of whom shall be a practicing architect, engineer or builder, of at least ten years' practice, appointed by the owner of said building or structure. In case the owner fails to appoint, or, having appointed, the said representative fails to attend according to notice, the two surveyors first named shall make the survey, and if they do not agree, they shall appoint another member, who shall be a practicing architect, engineer or builder of at least ten years' practice.

2. The architect, civil engineer, or builder appointed by the Mayor of the city of _____ who may serve on a committee of surveyors, as prescribed in Section 321, shall receive the sum of twenty-five dollars for each survey thereof, to be paid by the City Treasurer upon the voucher of the Superintendent. Should the owner fail to appoint and it become necessary for the committee to appoint another member as prescribed in this section, the member so appointed shall receive the sum of twenty-five dollars for each survey, payable as above.

PART XLIII.**GENERAL PROVISIONS.**

Section 326. Existing Suits and Liabilities. Nothing in this Code contained shall be construed to affect any suit or proceeding now pending in any court, or any rights acquired, or liability incurred, nor any cause or causes of action accrued or existing, under any act or ordinance repealed hereby. Nor shall any right or remedy of any character be lost, impaired or affected by this Code.

Section 327. Invalidity of One Section Not to Invalidate Any Other. The invalidity of any section or provision of this Code shall not invalidate any other section or provision thereof.

Section 328. Repealing Section. All former ordinances of the City of _____ affecting or relating to the Construction, Alteration or Removal of Buildings or other Structures, and all other ordinances or parts thereof inconsistent herewith, are hereby repealed.

Section 329. Date When Ordinance Is to Take Effect. This ordinance, to be known as the Building Code, shall take effect sixty days after its approval by the Mayor.

APPENDIX

The material included in the Appendix is explanatory or educational in character, and it is believed will be useful to those in charge of construction work under the requirements of this Code. As there was some question regarding the propriety of including the various items in the subject matter of the Code proper, it is placed here, leaving different city authorities to decide for themselves its appropriate disposition.

GRADING OF YELLOW PINE TIMBER.

It is generally admitted that it is practically impossible to always recognize the different species of yellow pine after being sawed into timber. In the past all yellow pine has usually been grouped into two classes—longleaf and shortleaf; the latter, which is often called North Carolina pine, being made to cover not only the true shortleaf pine, but all other varieties, including loblolly.

This classification has proved unsatisfactory, because of the uncertainty of making even this simple separation upon a botanical basis. Timber from trees of one species often possesses the physical characteristics of another species. Consequently it has long been recognized that the suitability of yellow pine timber for structural purposes should be determined by the character of its grain and density, and not by its botanical name.

The U. S. Forest Service, the American Society for Testing Materials, and various Yellow Pine Lumber Associations have spent much time studying this problem in an effort to establish a set of Standard Grading Rules acceptable to all interests, which will separate Southern yellow pine into commercial classes according to strength, using a method of inspection based upon the density of the wood as indicated by the number and character of yearly growth rings on the cross section, also the number, character and location of defects. They have all agreed upon the general principles for such rules, though minor points of difference still exist. These are now under discussion and will doubtless be settled in the near future. Trial forms of the rules have been put in practical operation by the U. S. Government and much Southern yellow pine for important timber structures is now sold under forms of grade specifications which have been put into use by different lumber associations with quite satisfactory results. When adjustment of minor differences has been accomplished, purchasing contracts can be executed without confusion.

Through the courtesy of the U. S. Forest Service we print a proposed revised form of such rules. They should prove of great assistance in lessening the disputes regarding the quality of such lumber, which are prevalent under the old system of classification.

RULES FOR GRADING STRUCTURAL TIMBERS OF SOUTHERN YELLOW PINE.

GRADE I.

1. *Requirements for Quality of Timber Based Upon Soundness and Density.*

(a) *Soundness.*—Shall contain only sound wood.

(b) *Density.*—As indicated by number of Rings and Proportion of Summerwood.—Shall show on the cross section an average of not less than one-third summerwood, measured over the third, fourth, and fifth inches on a radial line from the pith. Timber averaging less than six annual growth rings per inch shall show an average of not less than one-half summerwood. Contrast in color between summerwood and springwood shall be sharp.

In cases where timbers do not contain the pith, and it is impossible to locate it with any degree of accuracy by curvature of the rings, the inspection shall be made over three inches of an approximately radial line, beginning at the edge nearest the pith.

2. *Restrictions on Knots in Beams.*—Sound knots over $1\frac{1}{2}$ inches in diameter, or knots over $\frac{1}{2}$ inch in diameter

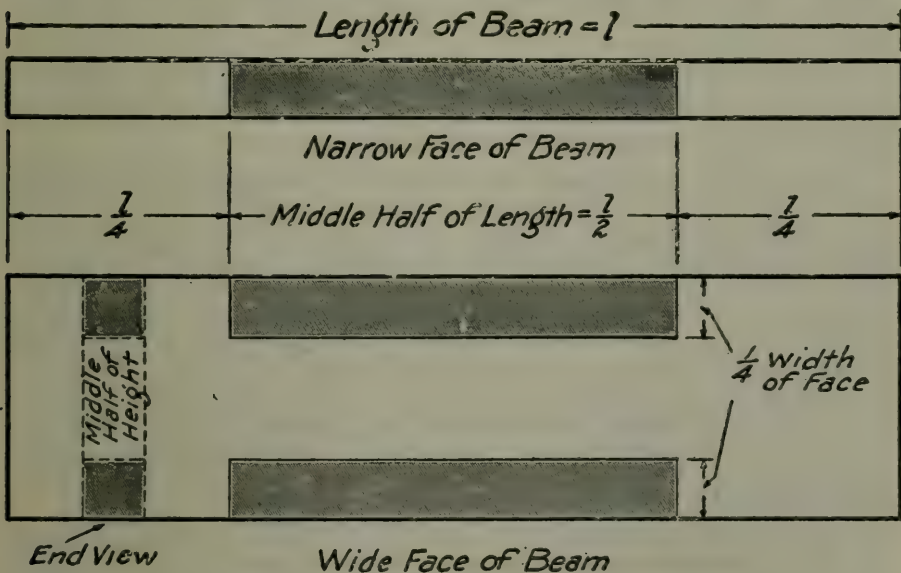


FIG. 41.

Plan and elevation of wooden beam, with shaded areas indicating portions in which certain knots are excluded.

which are insecurely attached to the surrounding wood, shall not be permitted in the middle half of the length of narrow or horizontal faces of beams; nor in the middle half of the length of the wide or vertical faces within a distance equal to one-fourth their width from the edges. See Fig. 41. No knot shall be permitted within these areas whose diameter exceeds one-fourth the width of the face on which it appears.

The aggregate diameter of all knots within the middle half of the length of any face shall not exceed the width of that face.

NOTE.—In measuring knots the average diameter shall be used.

3. *Restrictions on Knots in Columns.*—Sound knots having diameters greater than 4 inches or one-third the least dimension of a column, or knots over $\frac{1}{2}$ inch in diameter which are insecurely attached to the surrounding wood, shall not be permitted.

4. *Restrictions on Shakes and Checks in Beams.*—Ring-shakes shall not occupy at either end of a timber more than one-fourth the width for green material, nor more than one-third the width for seasoned material. Shakes shall not show on the faces of either green or seasoned timber.

Any combination of shakes and checks which would reduce the strength to a greater extent than the ring-shakes here allowed shall not be permitted.

NOTE.—The importance of shakes and checks in the middle half of the height of a beam is dependent upon the magnitude of the horizontal shearing stress. The specification given, is for beams in which the allowable shearing stress is attained. In beams whose length is more than 15 times their height, the allowable shearing stress is not usually developed, and as the ratio of length to height increases, the importance of these shakes and checks decreases proportionately. Ring-shakes showing on an end, should be considered as extending to the middle. Checks and radial or star-shakes are not usually continuous in the direction of the length of the timber, but should not be permitted if, in the judgment of the inspector, their weakening effect is greater than that of the allowable ring-shakes.

Permissible conditions for both green and seasoned material are given, because checks are formed, and shakes further developed, during seasoning. The maximum amount of shakes and checks should not be allowed unless it is practically certain from the appearance of the timber, or from a knowledge of the seasoning conditions or length of time elapsed since cutting, that it is

thoroughly seasoned. For purposes of this rule it shall be considered that at least $1\frac{1}{2}$ months per inch of thickness is required for timber to become thoroughly seasoned.

5. *Restrictions on Cross-grain in Beams.*—Shall not have diagonal grain with slope greater than one in twenty within the middle half of the length of the beam.

GRADE II.

6. *Requirements for Quality.*—Grade II includes timber rejected from Grade I on account of either (a), having less density than required for Grade I; or (b), having more serious defects than are allowed in Grade I.

(a) Timber rejected from Grade I because of deficient density, will be accepted in Grade II provided it meets all the requirements of Grade I, except that in Rule 1, (b), the requirements for *one-third* summerwood in material having six rings and over per inch, shall be changed to *one-fourth*; and that the requirements for *one-half* summerwood in material having less than six rings per inch, shall be changed to *one-third*.

(b) Timber rejected from Grade I for excess defects will be accepted in Grade II, provided its density conforms to Rule 1, (b), and its defects are limited as follows:—

7. *Restrictions on Knots in Beams.*—Sound knots over 3 inches in diameter or whose diameter exceeds one-half the width of the face on which they appear, or knots which are insecurely attached to the surrounding wood, whose diameter exceeds $1\frac{1}{2}$ inches or one-fourth the width of the face on which they appear, shall not be permitted in the middle half of the length of narrow or horizontal faces of beams; nor in the middle half of the length of wide or vertical faces within a distance equal to one-fourth their width from the edges.

The aggregate diameter of all knots within the middle half of the length of any face shall not exceed twice the width of that face.

8. *Restrictions on Knots in Columns.*—Sound knots having diameters greater than 6 inches or one-half the least dimension of a column, or knots insecurely attached to the surrounding wood, and having diameters greater than 3 inches or one-fourth the least dimension of a column, shall not be permitted.

9. *Restrictions on Shakes and Checks in Beams.*—Ring-shakes shall not occupy at either end of a timber, more than one-third the width for green material, nor more than one-half the width for seasoned material.

Any combination of shakes and checks which would reduce the strength to a greater extent than the ring-shakes here allowed, shall not be permitted. (See note to Rule 4.)

NOTE.—The following publications contain valuable information upon the subject of structural timbers:

Test of Structural Timbers, U. S. Forest Service Bulletin No. 108.

Air Seasoning of Timber, Wm. H. Kempfer, American Railway Engineering Association, Bulletin No. 161.

Factors Affecting Structural timber, H. S. Betts, Engineering Record, August 29, 1914.

Applicability of Yellow Pine Grading Rules to Other Timbers, J. A. Newlin, Engineering Record. Oct. 3, 1914.

Dry Rot in Factory Timbers, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

Report on Dry Rot in Wall-paper Factory, New York Board of Fire Underwriters, 1909.

EXPLANATORY NOTES ON GRADING RULES.

1. The density or dry weight of wood, is a measure of its strength.

2. Each annual growth ring of yellow pine is composed of a band of dense, heavy, dark, summerwood and a band of lighter, softer springwood. The greater the proportion of summerwood, the greater the weight and strength of the timber.

3. The principle of Rules 1 and 6, referring to the number of growth rings and the proportion of summerwood as a measure of density and hence of strength, applies to all woods in which there is a marked contrast between the character of the springwood and summerwood. The Forest Service is collecting data as a basis for density specifications for Douglas fir corresponding to those for Southern yellow pine. It does not appear desirable or practicable to specify density or summerwood requirements for other woods used for structural purposes such as hemlock and spruce, since they do not commonly show wide variations in growth rings and density. However, timbers

of exceptionally low density should not be admitted to Grade I; but may be classed in Grade II if their defects are restricted as in Rules 2, 3, 4, and 5:

4. The Rules which refer to defects, are applicable to other structural timbers as well as to Southern yellow pine.

5. The number, character, and location of defects in timber has much to do with its strength value. Checks and shakes in beams reduce the area which resist horizontal shear. Such defects are most harmful in the middle half of the height of a beam, as they are then comparatively near the neutral plane where their effect is greatest. The best place to judge of the effect of such defects is on the ends of the timber.

6. The weakening effect of knots also depends upon their position, as well as their soundness, tightness, and the amount they distort the grain of the wood from a straight line. A comparatively small knot near the lower edge of a beam may be more harmful than a large knot located elsewhere. For example, a series of tests made upon loblolly yellow pine beams by the U. S. Forest Service, showed that the average strength of such beams with knots located in the bottom quarter of the middle half of the beams, was reduced 25 per cent. below that of similar beams with knots located in other portions. In some cases a knot near the neutral plane may act as a pin and serve to strengthen the beam against failure by horizontal shear.

7. Sapwood is as strong as heartwood but not so durable. It is not detrimental in timber to be treated with preservatives, but where timber is to be used untreated, three-quarters heart should show at any part on the narrow faces of stringer forms. Other forms more nearly square should show three-quarters heart at any point on all faces.

8. Rough sawed timbers should not be more than $\frac{1}{4}$ inch, nor dressed timbers more than $\frac{1}{2}$ inch scant of nominal size; that is, a nominal 12"x12" timber should not be less than $11\frac{3}{4}$ "x $11\frac{3}{4}$ " when sawed, or $11\frac{1}{2}$ "x $11\frac{1}{2}$ " when dressed. (See Note on page 286.)

STRENGTH OF RECTANGULAR WOODEN BEAMS.

In the computations for the strength of rectangular wooden beams given in Tables I to VI inclusive, the following general formulas based upon the theory of flexure were employed:

$$w_f = \frac{f}{9} \times \frac{bd^2}{cl^2} \quad - \quad - \quad - \quad - \quad (1)$$

$$w_s = \frac{4}{3} \times \frac{bds}{cl} \quad - \quad - \quad - \quad - \quad (2)$$

$$W_f = \frac{f}{9} \times \frac{bd^2}{l} \quad - \quad - \quad - \quad - \quad (3)$$

$$W_s = \frac{4}{3} \times bds \quad - \quad - \quad - \quad - \quad (4)$$

w_f = Safe load in lbs. per sq. ft. as determined by the allowable extreme fibre stress, (bending).

w_s = Safe load in lbs. per sq. ft. as determined by the allowable longitudinal shear.

W_f = Total distributed load in lbs. as determined by the allowable extreme fibre stress.

W_s = Total distributed load in lbs. as determined by the allowable longitudinal shear.

f = Allowable extreme fibre stress in lbs. per sq. inch, tension or compression.

s = Allowable longitudinal shear in lbs. per sq. inch.

b = Thickness of beam in inches.

d = Depth of beam in inches.

c = Distance in feet between floor beams center to center.

l = Span of beam in feet.

Example 1. Required, the safe distributed load per sq. ft. on a floor construction of 3×12 inch Grade I, yellow pine beams with a span of 20 feet, and spaced 16 inches, center to center.

The table in Section 65, par. 4, gives,
 $f = 1600$ lbs., and $s = 120$ lbs.

Statement of the problem gives,
 $b = 3$ ins., $d = 12$ ins., $l = 20$ ft., $c = 1\frac{1}{3}$ ft.

These values substituted in formulas (1) and (2) give,

$$w_f = \frac{1600}{9} \times \frac{3 \times 12 \times 12}{1\frac{1}{3} \times 20 \times 20} = 144 \text{ lbs.}$$

$$w_s = \frac{4}{3} \times \frac{3 \times 12 \times 120}{1\frac{1}{3} \times 20} = 216 \text{ lbs.}$$

The smaller of the two values determines the allowable load. Hence the safe distributed load on the floor would be 144 lbs. per sq. ft., including the dead weight of the floor construction.

Example 2. Required, the total safe distributed load on a Grade II, Yellow Pine girder 8×16 inches, with a span of 16 ft. center to center of supports.

The table in Section 65, par. 4, gives,

$f = 1200$ lbs., and $s = 85$ lbs.

Statement of the problem gives,

$b = 8$ ins., $d = 16$ ins., and $l = 16$ ft.

These values substituted in formulas (3) and (4) gives:—

$$W_f = \frac{1200}{9} \times \frac{8 \times 16 \times 16}{16} = 17055 \text{ lbs.}$$

$$W_s = \frac{4}{3} \times 8 \times 16 \times 85 = 14506 \text{ lbs.}$$

Here again the smaller value is the determining one.

Hence, the total safe distributed load for the girder is 14506 lbs.

TABLES OF ALLOWABLE FLOOR LOADS.

NOTE

The following tables were calculated from the working stresses given in Section 65, par. 4.

The calculations are made upon exact sizes. Commercial sizes are approximately $\frac{1}{4}$ to $\frac{5}{8}$ inch less, in each dimension; it is very important to keep this fact in mind when using the tables.

The influence of this difference in size is greatest on small dimension stock such as would be used for light floor joists, or for struts supporting reinforced concrete forms. Safe load values for small size sticks of considerable length, may in some cases be 10 to 30 per cent. below those given in the tables; it is therefore advisable for such stock to use values somewhat less than those which the tables indicate.

The variation between exact and commercial sizes is not the same for all woods, which explains why the tables were calculated for exact size.

Rectangular Beams of Yellow Pine Grade I

Extreme fibre stress 1600 lbs. per square inch

Longitudinal shear 125 " " "

Safe distributed loads in pounds per square foot for beams 3 inches thick and spaced 16 inches on centres.

For beams 2 inches thick deduct one-third of load.

For beams 4 inches thick add one-third of load.

For beams spaced 12 inches on centres add one-third of load.

For beams spaced 20 inches on centres deduct one-fifth of load.

Correct to ± 1 pound

Safe distributed total loads in pounds for beams one inch thick.

For other thicknesses multiply the load in the table by the thickness of the beam in inches.

Correct to ± 5 pounds

Span in feet	Size of Beams in inches						Depth of Beams in inches							Span in feet
	3x6	3x8	3x9	3x10	3x12	3x14	6	8	9	10	12	14	16	
8	225	375	422	469	562	656	800	1335	1500	1665	2000	2335	2665	8
9	206	316	375	417	500	584	710	1265	1500	1665	2000	2335	2665	9
10	144	256	324	375	450	525	640	1135	1440	1665	2000	2335	2665	10
11	119	211	267	330	409	477	580	1030	1305	1615	2000	2335	2665	11
12	100	178	225	278	375	437	530	945	1200	1480	2000	2335	2665	12
13	85	152	192	237	341	403	490	875	1105	1370	1970	2335	2665	13
14	74	131	165	204	294	375	455	815	1025	1270	1825	2335	2665	14
15	64	114	144	178	256	349	425	760	960	1185	1710	2325	2665	15
16	56	100	126	156	225	306		710	900	1110	1600	2180	2656	16
17	50	88	112	138	199	271		670	850	1045	1505	2050	2665	17
18		79	100	123	178	242		630	800	990	1420	1935	2530	18
19		71	89	110	159	217		595	755	935	1345	1835	2390	19
20		64	81	100	144	196		570	720	890	1280	1745	2280	20
21		58	73	90	130	177			685	850	1220	1660	2165	21
22		53	67	83	119	162			655	810	1165	1585	2070	22
23			61	76	109	148				775	1110	1515	1975	23
24			56	69	100	136				740	1065	1450	1890	24
25				64	92	125				710	1025	1395	1820	25
26				59	85	116				675	985	1340	1750	26
27				55	79	107				660	950	1290	1685	27
28					74	100					915	1240	1620	28

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear and are the MAXIMUM SAFE LOADS.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

TABLE II

Rectangular Beams of Yellow Pine Grade II

Extreme fibre stress 1300 lbs. per square inch

Longitudinal shear 85 " " " "

Safe distributed loads in pounds per square foot for beams 3 inches thick and spaced 16 inches on centres.

For beams 2 inches thick deduct one-third of load.

For beams 4 inches thick add one-third of load.

For beams spaced 12 inches on centres add one-third of load.

For beams spaced 20 inches on centres deduct one-fifth of load.

Correct to ± 1 pound

Safe distributed total loads in pounds for beams one inch thick.

For other thicknesses multiply the load in the table by the thickness of the beam in inches.

Correct to ± 5 pounds

Span in feet	Size of Beams in inches						Depth of Beams in inches							Span in feet
	3x6	3x8	3x9	3x10	3x12	3x14	6	8	9	10	12	14	16	
8	183	255	287	319	382	446	650	910	1020	1130	1360	1590	1815	8
9	144	226	255	284	340	397	580	910	1020	1130	1360	1590	1815	9
10	117	204	230	255	306	357	520	910	1020	1130	1360	1590	1815	10
11	97	172	209	232	278	324	475	840	1020	1130	1360	1590	1815	11
12	81	144	183	213	255	297	435	770	975	1130	1360	1590	1815	12
13	69	123	155	193	235	275	400	710	900	1110	1360	1590	1815	13
14	59	106	134	166	218	255	370	660	835	1030	1360	1590	1815	14
15	52	92	117	144	204	238	345	615	780	965	1360	1590	1815	15
16		81	103	127	183	223	325	575	730	905	1300	1590	1815	16
17		72	91	112	162	210		545	690	850	1225	1590	1815	17
18		64	81	100	145	197		515	650	805	1155	1575	1815	18
19		58	73	90	129	176		485	615	760	1095	1490	1815	19
20		52	66	81	117	159		460	585	725	1040	1430	1815	20
21			59	73	106	144		440	555	690	990	1345	1755	21
22			54	67	97	132		420	530	655	945	1285	1680	22
23			50	16	89	121		400	510	630	905	1230	1605	23
24				56	81	110		385	490	600	865	1180	1540	24
25				52	75	102		345	470	580	830	1130	1480	25
26					69	94			450	555	800	1085	1425	26
27					64	87			435	535	770	1050	1370	27
28					60	81					745	1010	1320	28

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear and are the MAXIMUM SAFE LOADS.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Rectangular Beams of Douglas Fir

Extreme fibre stress 1500 lbs. per square inch

Longitudinal shear 100 " " " "

Safe distributed loads in pounds per square foot for beams 3 inches thick and spaced 16 inches on centres.

For beams 2 inches thick deduct one-third of load.

For beams 4 inches thick add one-third of load.

For beams spaced 12 inches on centres add one-third of load.

For beams spaced 20 inches on centres deduct one-fifth of load.

Correct to ± 1 pound

Safe distributed loads in pounds for beams one inch thick.

For other thicknesses multiply the load in the table by the thickness of the beam in inches.

Correct to ± 5 pounds

Span in feet	Size of Beams in inches						Depth of Beams in inches							Span in feet
	3x6	3x8	3x9	3x10	3x12	3x14	6	8	9	10	12	14	16	
8	210	300	338	375	451	527	750	1070	1200	1330	1600	1870	2130	8
9	167	268	300	334	400	468	670	1070	1200	1330	1600	1870	2130	9
10	135	<u>241</u>	270	300	360	421	600	<u>1070</u>	1200	1330	1600	1870	2130	10
11	110	198	<u>246</u>	273	327	383	550	970	<u>1200</u>	1330	1600	1870	2130	11
12	94	167	212	<u>250</u>	300	351	500	890	<u>1130</u>	<u>1330</u>	1600	1870	2130	12
13	80	142	180	222	277	324	460	820	1040	<u>1280</u>	1600	1870	2130	13
14	69	122	154	191	257	301	430	760	960	1190	1600	1870	2130	14
15		106	135	166	<u>240</u>	281		710	900	1110	<u>1600</u>	1870	2130	15
16		94	118	146	211	263		670	840	1040	1500	1870	2130	16
17		83	106	130	187	<u>248</u>		630	800	980	1410	<u>1870</u>	2130	17
18		75	94	116	167	228		600	750	930	1330	1820	2130	18
19		66	84	104	149	206		560	710	880	1260	1720	2130	19
20		61	77	93	135	186		540	680	830	1200	1640	<u>2130</u>	20
21			69	85	122	167			640	790	1140	1560	2030	21
22			62	78	112	153			610	760	1090	1490	1940	22
23				71	102	140				730	1040	1430	1850	23
24				65	94	128				690	1000	1370	1780	24
25					86	119					960	1320	1700	25
26					80	110					920	1270	1640	26
27					74	102					890	1220	1580	27
28					69	95					860	1180	1520	28

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear and are the MAXIMUM SAFE LOADS.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

TABLE IV

Rectangular Beams of Spruce or Norway Pine

Extreme fibre stress 1000 lbs. per square inch
 Longitudinal shear 75 " " " "

Safe distributed loads in pounds per square foot for beams 3 inches thick and spaced 16 inches on centres.

For beams 2 inches thick deduct one-third of load.

For beams 4 inches thick add one-third of load.

For beams spaced 12 inches on centres add one-third of load.

For beams spaced 20 inches on centres deduct one-fifth of load.

Correct to ± 1 pound

Safe distributed loads in pounds for beams one inch thick.

For other thicknesses multiply the load in the table by the thickness of the beam in inches.

Correct to ± 5 pounds

Span in feet	Size of Beams in inches						Depth of Beams in inches							Span in feet
	3x6	3x8	3x9	3x10	3x12	3x14	6	8	9	10	12	14	16	
8	140	225	253	282	337	395	500	800	900	1000	1200	1400	1600	8
9	112	200	225	225	300	350	450	800	900	1000	1200	1400	1600	9
10	90	160	205	202	270	315	400	710	900	1000	1200	1400	1600	10
11	73	133	157	184	245	287	360	650	770	1000	1200	1400	1600	11
12	63	111	141	174	225	263	330	590	750	930	1200	1400	1600	12
13		95	119	148	208	243		550	690	860	1200	1400	1600	13
14		82	103	127	183	225		510	640	790	1140	1400	1600	14
15		71	90	111	161	210		470	600	740	1070	1400	1600	15
16		62	79	98	140	191		450	560	700	1000	1360	1600	16
17		55	70	86	124	170		420	530	650	940	1280	1600	17
18		50	62	77	111	151		400	500	620	890	1210	1580	18
19			56	69	100	136			470	580	840	1150	1500	19
20			51	63	90	123			450	560	800	1090	1430	20
21				57	81	111				530	760	1040	1360	21
22				52	75	101				510	730	990	1300	22
23					68	93					700	950	1240	23
24					63	85					670	910	1190	24
25						79						870	1140	25
26						73						840	1100	26
27						68						810	1060	27
28						63						780	1020	28

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear and are the MAXIMUM SAFE LOADS.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Rectangular Beams of Western Hemlock

Extreme fibre stress 1300 lbs. per square inch

Longitudinal shear 75 " " " "

Safe distributed loads in pounds per square foot for beams 3 inches thick and spaced 16 inches on centres.

For beams 2 inches thick deduct one-third of load.

For beams 4 inches thick add one-third of load.

For beams spaced 12 inches on centres add one-third of load.

For beams spaced 20 inches on centres deduct one-fifth of load.

Correct to ± 1 pound

Safe distributed loads in pounds for beams one inch thick.

For other thicknesses multiply the load in the table by the thickness of the beam in inches.

Correct to ± 5 pounds

Span in feet	Size of Beams in inches						Depth of Beams in inches							Span in feet
	3x6	3x8	3x9	3x10	3x12	3x14	6	8	9	10	12	14	16	
8	169	225	253	282	338	395	600	800	900	1000	1200	1400	1600	8
9	145	200	224	250	300	350	580	800	900	1000	1200	1400	1600	9
10	117	180	202	225	270	315	520	800	900	1000	1200	1400	1600	10
11	96	164	184	205	246	287	470	800	900	1000	1200	1400	1600	11
12	81	144	168	188	225	263	430	770	900	1000	1200	1400	1600	12
13	69	123	155	173	208	243	400	710	900	1000	1200	1400	1600	13
14	60	106	135	160	193	225	370	660	840	1000	1200	1400	1600	14
15		93	117	145	180	210		620	780	970	1200	1400	1600	15
16		81	103	126	169	197		580	730	900	1200	1400	1600	16
17		71	91	112	159	186		540	690	850	1200	1400	1600	17
18		64	81	100	145	175		510	650	800	1160	1400	1600	18
19			73	90	130	166			620	760	1100	1400	1600	19
20			66	81	117	157			590	720	1040	1400	1600	20
21				74	105	145				690	990	1350	1600	21
22				68	97	132				660	950	1290	1600	22
23				62	89	121				630	910	1240	1600	23
24				56	82	111				600	870	1180	1540	24
25					75	103					830	1140	1480	25
26					69	94					800	1090	1420	26
27					64	88					770	1050	1370	27
28					59	81					740	1010	1320	28

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear and are the MAXIMUM SAFE LOADS.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

TABLE VI

Rectangular Beams of Oak

Extreme fibre stress 1400 lbs. per square inch
 Longitudinal shear 120 " " " "

Safe distributed loads in pounds per square foot for beams 3 inches thick and spaced 16 inches on centres.

For beams 2 inches thick deduct one-third of load.

For beams 4 inches thick add one-third of load.

For beams spaced 12 inches on centres add one-third of load.

For beams spaced 20 inches on centres deduct one-fifth of load.

Correct to ± 1 pound

Safe distributed loads in pounds for beams one inch thick.

For other thicknesses multiply the load in the table by the thickness of the beam in inches.

Correct to ± 5 pounds

Span in feet	Size of Beams in inches						Depth of Beams in inches							Span in feet
	3x6	3x8	3x9	3x10	3x12	3x14	6	8	9	10	12	14	16	
8	197	349	405	450	542	632	700	1240	1440	1600	1920	2240	2560	8
9	155	275	350	400	481	560	620	1100	1400	1600	1920	2240	2560	9
10	126	224	284	352	432	504	560	990	1260	1560	1920	2240	2560	10
11	103	184	231	288	393	458	510	900	1150	1410	1920	2240	2560	11
12	87	155	197	242	351	420	470	830	1050	1290	1870	2240	2560	12
13	74	133	168	206	295	388	430	770	970	1190	1720	2240	2560	13
14	65	115	144	178	256	350	400	710	900	1110	1600	2180	2560	14
15		100	126	156	223	305		660	840	1040	1490	2030	2560	15
16		78	119	136	197	268		620	790	970	1400	1900	2500	16
17		69	98	122	173	237		580	740	920	1320	1790	2350	17
18		62	87	108	156	212		550	700	870	1240	1690	2220	18
19		56	79	97	140	190			660	820	1180	1600	2100	19
20			71	87	126	171			630	780	1120	1520	1990	20
21			65	80	114	156			600	740	1070	1450	1900	21
22			59	73	104	142			570	710	1020	1390	1810	22
23				67	94	130				680	970	1330	1730	23
24				61	87	119				650	930	1270	1660	24
25					81	110					900	1220	1590	25
26					74	102					860	1170	1530	26
27					69	94					830	1130	1480	27
28					64	88					800	1090	1420	28

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

Loads above and to the right of the heavy zigzag line are determined by the longitudinal shear and are the MAXIMUM SAFE LOADS.

Loads below and to the left of the heavy zigzag line are determined by the extreme fibre stress.

APPLICATION OF TEST LOAD FORMULAS FOR FLOOR SLABS.

See Section 175.

Determination of the factor of safety as influenced by the moments produced by a load applied at the third points, and an equivalent uniformly distributed load.

Let W = Sum of the two concentrated loads applied on test slab at third points.

W_u = Equivalent uniform load.

W_s = Allowable live load on the construction.

M = External moment with third point loading.

M_u = External moment with uniform load.

Simple Slabs

$$\frac{M}{M_u} = \frac{\frac{1}{6}}{\frac{1}{8}} = \frac{8}{6} = \frac{4}{3}$$

Therefore $\frac{W_u}{W} = \frac{4}{3}$, or $W = \frac{3}{4} W_u$

Now $W_s = \frac{1}{6} W = \frac{1}{6} \times \frac{3}{4} W_u = \frac{1}{8} W_u$ - - (1)

Hence the factor of safety on the equivalent uniform load is 8.

Restrained Slabs

$$\frac{M}{M_u} = \frac{\frac{1}{7.2}}{\frac{1}{10.5}} = \frac{10.5}{7.2} = 1.46$$

Therefore $\frac{W_u}{W} = 1.46$, or $W = \frac{W_u}{1.46}$

Now $W_s = \frac{1}{6} W = \frac{1}{6} \times \frac{W_u}{1.46} = \frac{1}{8.76} W_u$ - - - (2)

Hence the factor of safety on the equivalent uniform load is $8\frac{3}{4}$.

If w = the safe allowable live load in pounds per square foot.

b = width of test slab in feet.

l = span of slab in feet, center to center of I beam supports.

Then with a factor of safety of 6 on the test load, we would have

$$w = \frac{1}{6} \frac{W}{bl}$$

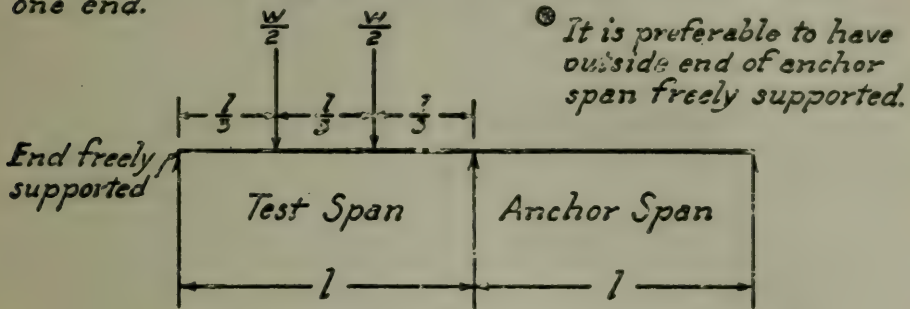
Or, Assume that a test slab failed under a total load of 18,000 pounds applied at the two points of concentration

Assume $b = 4$ feet, and $l = 6$ feet.

Then $w = \frac{18,000}{6 \times 4 \times 6} = 125$ pounds per square foot, as a safe live load.

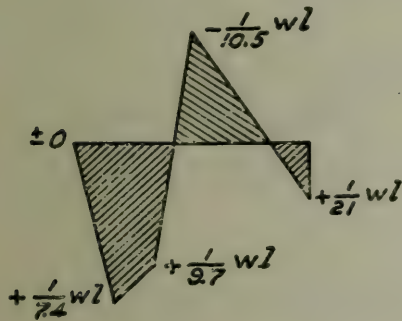
Moment Diagrams for Test Loads Indicating Coefficient for Bending and Shear.

Third point loading with construction continuous at one end.



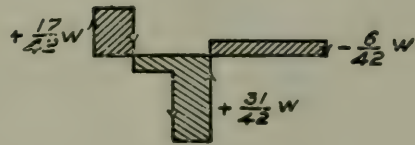
Bending Moments

Anchor span fixed both ends.

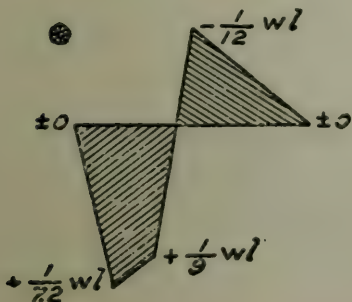


Shear

Anchor span fixed both ends.



Anchor span one end free.



Anchor span one end free.

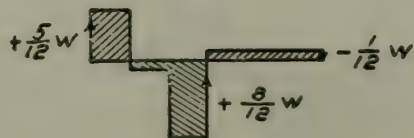
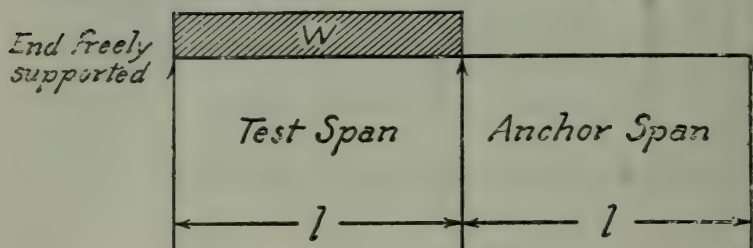


FIG. 42.

Moments and shears produced by third-point loading of floor slabs.
See Section 175.

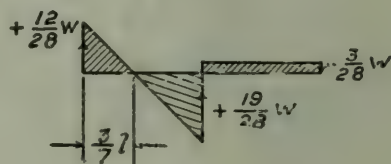
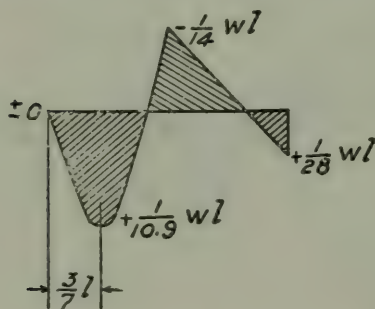
Moment Diagrams for Uniform Loads.
For purpose of comparison with test load diagram.



Bending Moments

Shear

Anchor span fixed both ends. Anchor span fixed both ends.



Anchor span one end free. Anchor span one end free.

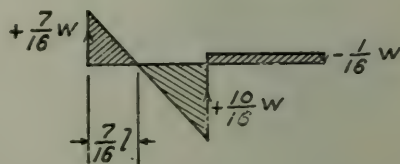
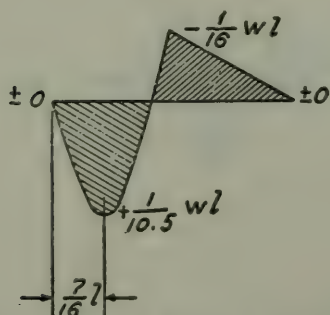


FIG. 43.

Moments and shears produced by uniform loading of floor slabs.

HOLLOW BUILDING BLOCKS.

NOTE.—In the specifications governing quality of hollow building blocks as given in Section 58, no requirement is made for minimum thickness of shells and webs and none is necessary if the blocks meet the strength tests specified. However, if hollow building tile are to be used at a place where testing facilities are not available and it is impossible to secure proper tests, a minimum thickness of 1 inch for shells (inclusive of plaster key) and $\frac{3}{4}$ inch for webs, should be required for blocks in all bearing walls in buildings of importance, or over one story in height. Concrete blocks used under the same conditions should have a minimum thickness of both shells and webs of 2 inches.

This statement should not be interpreted as implying that tests of such material are unnecessary or of secondary importance; they are essential to secure a uniform reliable product and safe construction. They should be required in every case where it is possible to obtain them.

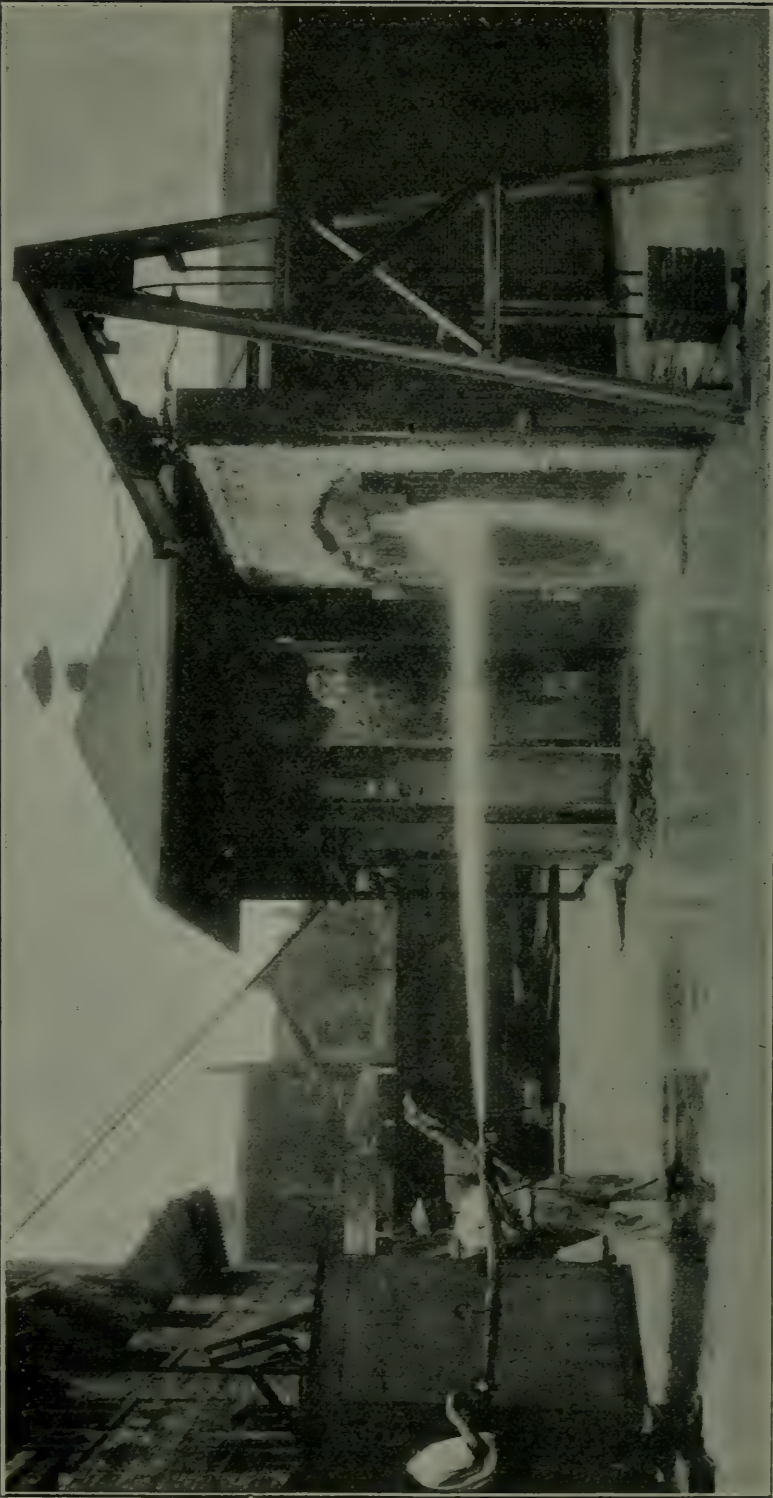


FIG. 44.

Furnace at the Underwriters' Laboratories for testing wall and partition panels, also fire doors and windows. Photograph shows wall panel removed from furnace after fire test, and application of hose stream. Section 174, pars. 6 and 7.

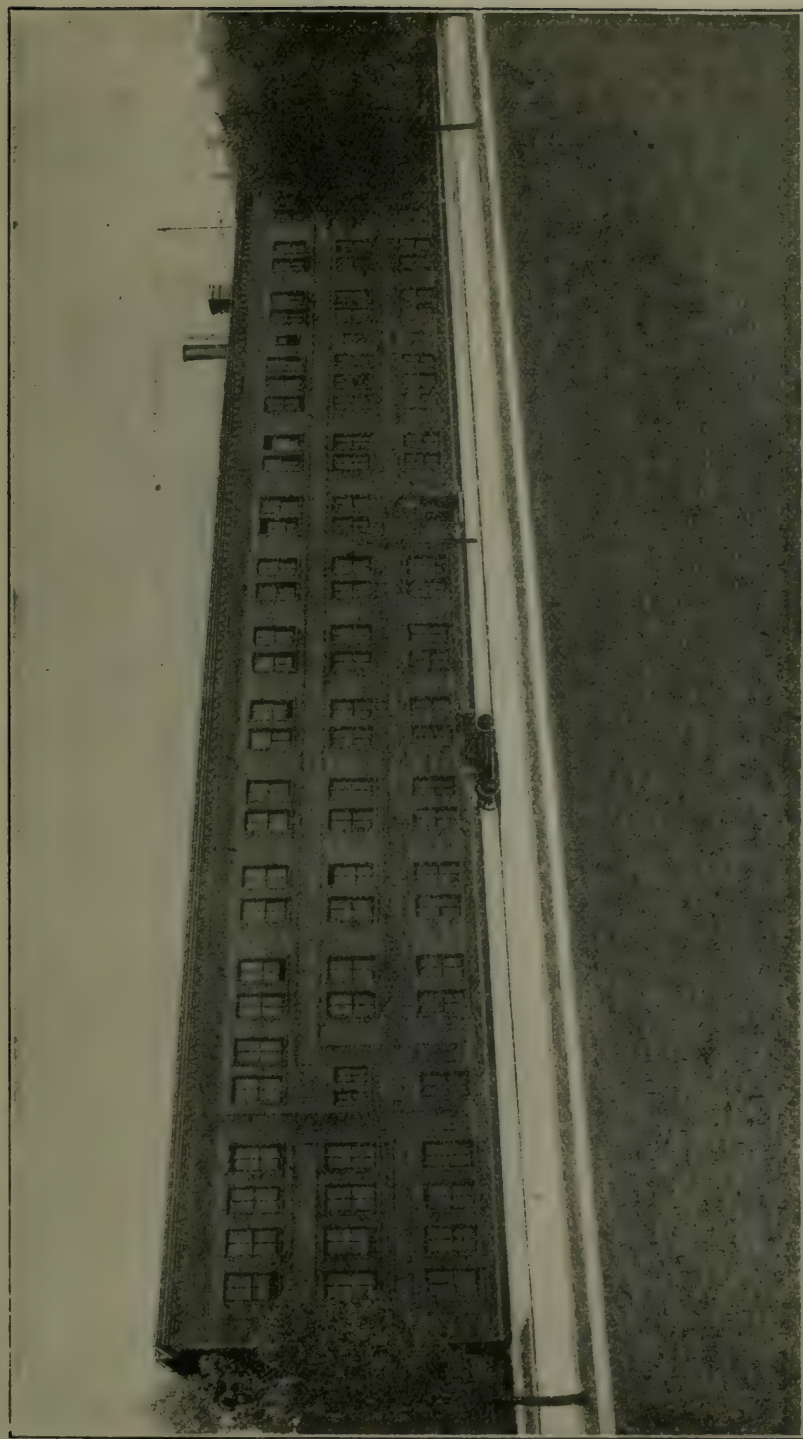
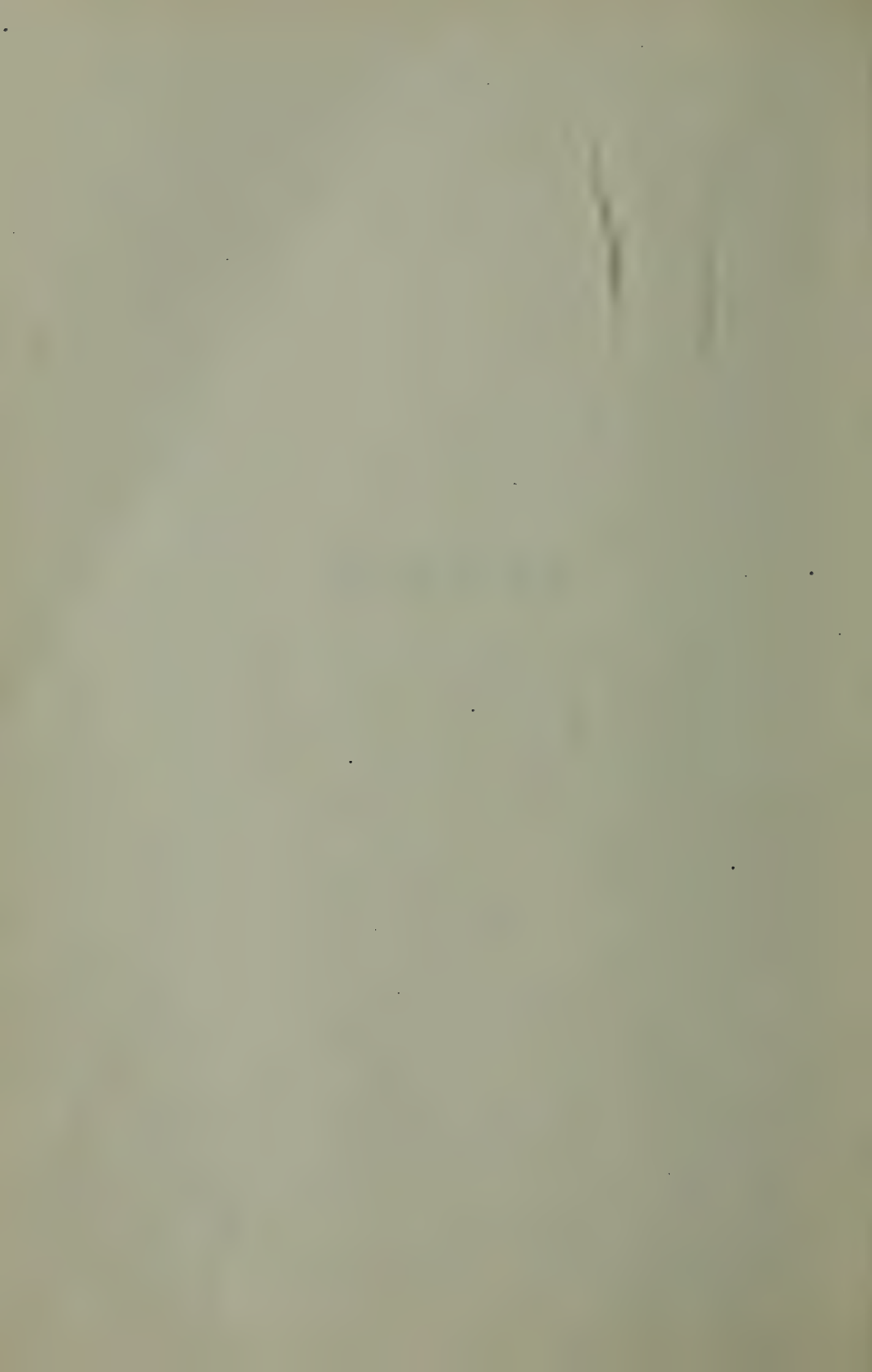


FIG. 45.

Underwriters' Laboratories at Chicago. Designed for testing fire protective devices and fireproofing materials. The most complete laboratory of its kind in the world. Floor area 45,000 square feet. Number of employees at home plant 112.



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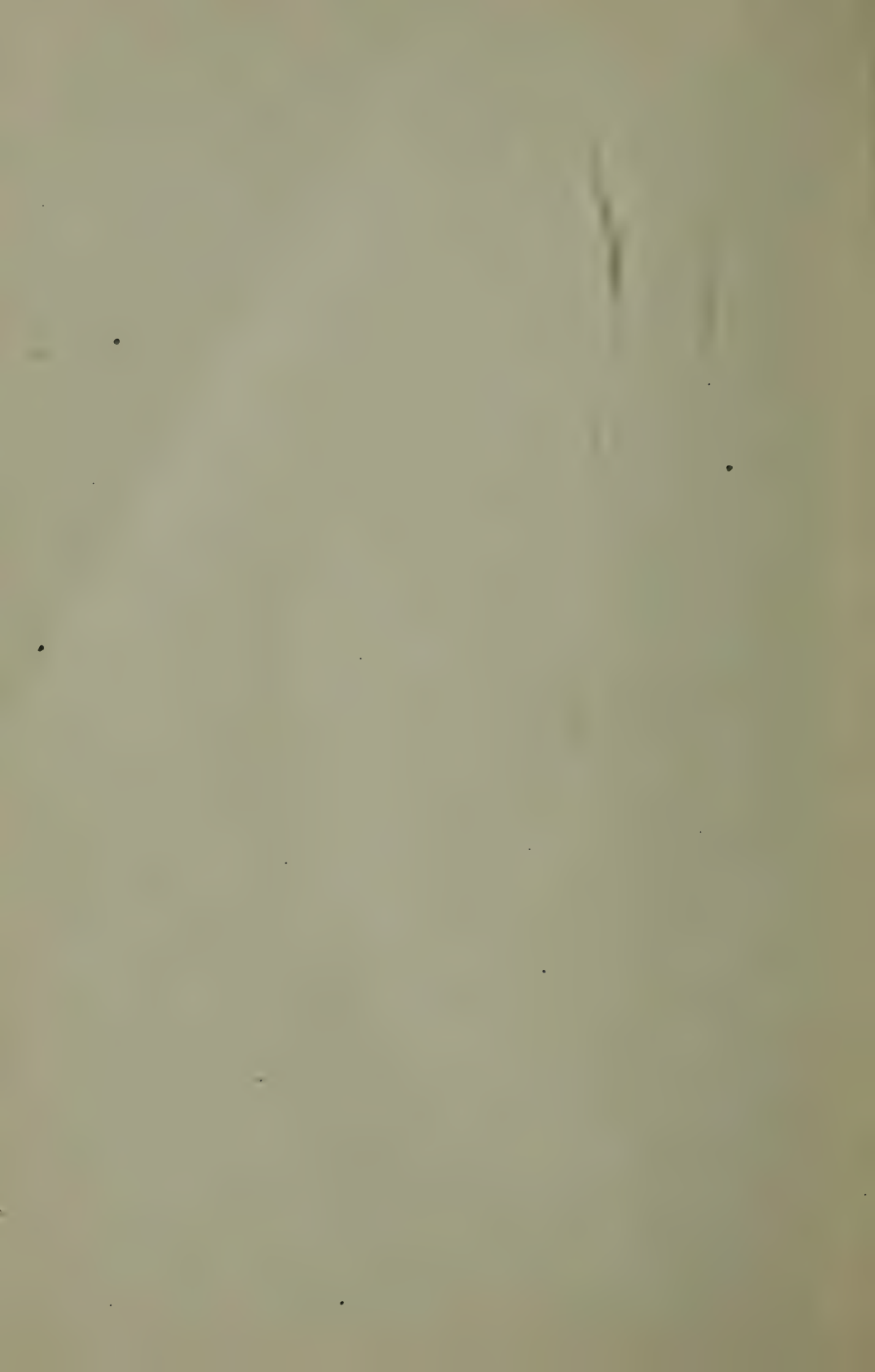
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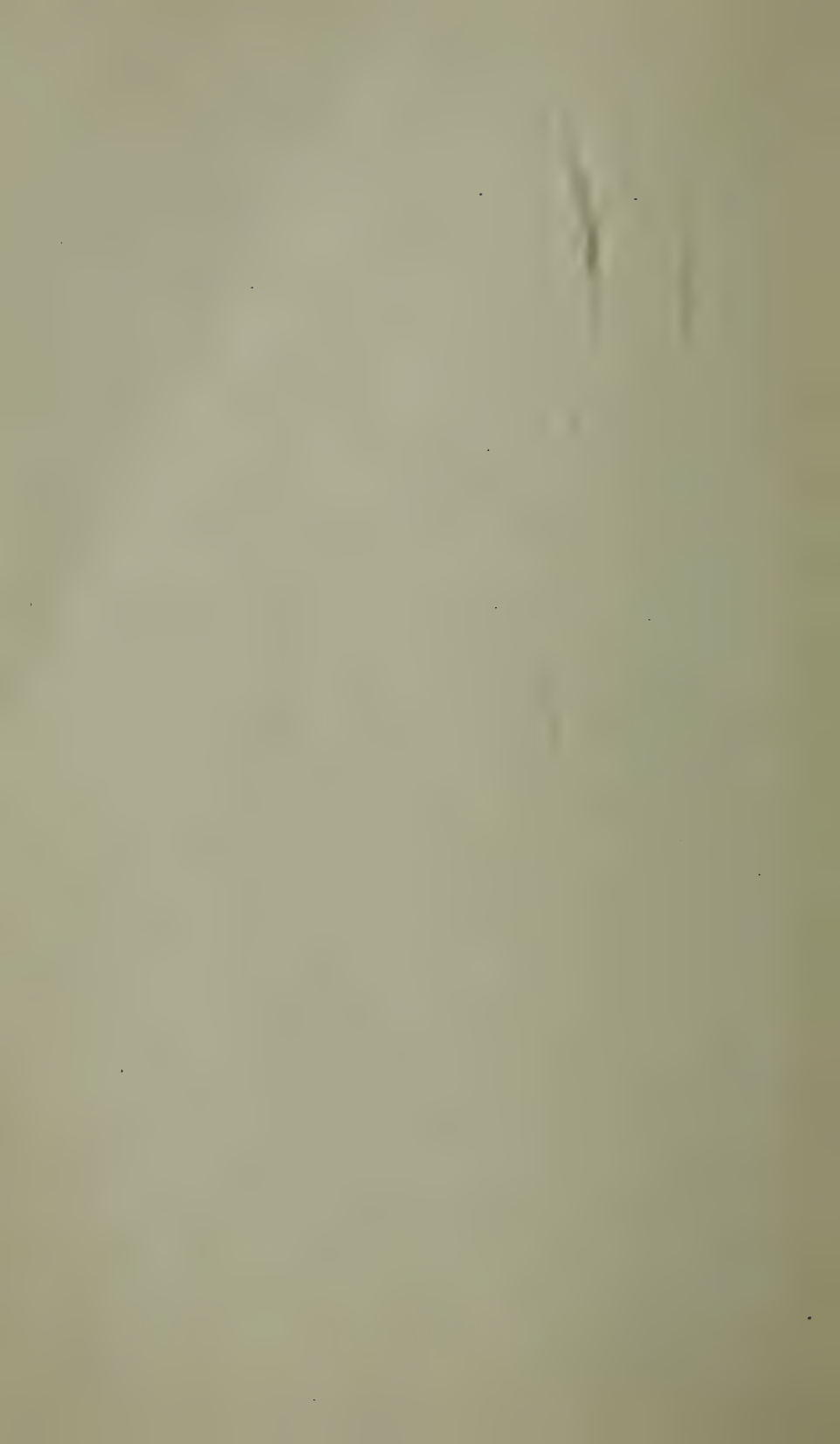
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